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No. 2.—Vol. 14.
August, 1893.

The Practical Teacher

Price Sixpence.

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The Practical Teacher

A MONTHLY EDUCATIONAL JOURNAL.

Edited by JOSEPH HUGHES.

'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

VOL. XIV. NO. 2. AUGUST, 1893. { PRICE, 6D. / POST FREE, 8D.

COMING MEN.

INTRODUCTORY.

'HE will arrive,' is the English phrase; 'he will emerge,' say the French, referring both to the 'coming man,' about whose personality dwell indefinable prophetic signs of eventual distinction. 'He will arrive at his goal,' means the English phrase; 'he will emerge from the ruck,' means the French; and though the battle be not always to the strong, or the race to the swift, few men of whom these prophecies have been commonly uttered fail to achieve the laurel. The general popular estimate of general average powers enables popular opinion to estimate the superior man's capacity; and a common prediction of coming distinction is seldom falsified, unless the object of the prophecy stabs his growing powers or his accumulating repute with his own hand. Immorality, intemperance, or even mere folly, are daggers with which many a 'coming man' has committed the suicide of his prospects; but, avoiding these, and scorning to rest satisfied with a demi-semi-success—a *succès d'estime*—the man of parts may surely count on persistent industry, and applied capacity beyond the common, to win for him distinction and the benefits which accompany it. To *begin* to succeed is not difficult; and, having begun, to continue to succeed is easier still, for 'nothing succeeds like success.' The road to success is not mapped or charted, but it is surprisingly easy to find; the difficulty is the following it, and the continuing to follow it. A book of ravishing and absorbing interest remains to be written; it is a book in which 'men who have risen' shall be induced to tell, each for himself, how he saw afar off the opportunity, how he strove, how he was baffled time and again, how finally he rose, and what he has learned of the route to fame whilst struggling along it. Sometimes a successful man will drop a golden hint or two; sometimes a biographer may feebly indicate a clue; but most often modesty or policy forbid, and the world is thus the poorer. Each for himself, therefore, the aspirants must puzzle out the problem, trace and retrace the path, 'train' for the race, arm for the battle. Yet there are a few general principles which may be indicated to the ambitious—principles and observations which are only quite obvious, perhaps, to those who in some degree have run the race and fought the battle successfully.

And *first*, distinction, greatness, are relative terms. The 'village Hampden who, with dauntless mien, the little tyrant of his fields withstood,' was as great, if one considers his starting-point and opportunities, as was John Hampden himself, considering the starting-point and opportunities which were *his*. The coterie, Society, and *clique* are arenas for the smaller kinds of fame and distinction, no doubt; but the causes of distinction are much the same in a coterie as in Parliament itself. Leading teachers, for instance, are as great, in their own way, and upon their own stage, as any of the notabilities whose doings the general press delight to chronicle. The chair of the N.U.T., and the Presidency of the Wesleyan Conference, are really greater in their way than the Primacy or the Lord Chancellorship, for they are filled by the vote of the constituents direct, without possibility of backstairs influence or favouritism. Of course the final crowning test of greatness is supreme distinction in some of the seven or eight vocations which the world delights to honour. Yet it is not given to many to have any fair chance of such distinction; to all, however, is given the chance of 'emerging from the ruck' of competitors and whilom equals in some line of life or other; and it matters little (for the purpose of this argument) what that line of life may be.

Secondly, success is also a relative term. So much depends on the starting-point, the advantages or disadvantages of birth and pocket, the circumstances of early life. The younger Pitt would hardly have been Premier at twenty-five had not Chatham been his father. Had Grattan started in the House of Commons, instead of in the Irish Legislature, his name would have been written by the pen of history on the roll of English Prime Ministers. Half the men in the House of Commons would never have penetrated the lobby had they been born poor.

BRITISH MUSEUM

West was thought to be a great painter merely because he was 'the best of a bad lot' in days when English art was at zero. Trevithick was as successful with the steam-engine as was Stephenson, though his name is less known. In weighing and measuring fame the circumstances of its pursuit must be remembered. Genius, of course, will overcome any obstacle, and so will talent if it be blest with pertinacious industry, hope, and health; but even by genius and industrious talent, if advantages of pocket and position be possessed the laurel will the sooner and the easier be won. The poor lad from an ignorant home who becomes professor or major is as successful, relatively, as the boy 'born with a silver spoon' who becomes Right Honourable or K.G.

Thirdly, other things being equal, the secret of success is persistence. 'Whatsoever thy hand findeth to do, do it with all thy might,' is an adage incomplete; 'do what lieth next thy hand to do,' is needed as supplement and explanation. Many of the failures in life are due to unwise choice of career, no doubt; but more of the failures are due to hesitation, half-heartedness, and want of persistence after the career has begun. The man who is beaten back by the first half-dozen obstacles will never mount and master the Hill Difficulty. The man who is always dreaming of what he *would* do were he only a doctor, or a preacher, or engineer, or what not, will never do much at anything. Most people during the first half of life are dissatisfied with the *métier* which has been allotted them; but the wise man does not so much seek to escape from his environment at once—at any cost—as to use it and mould it into a platform and spring-board from which he may step higher. Are you in a groove, a groove from which there appears no outlet, and at the end of which appears no prospect of distinction? Then do not try to *leap* out of it, or *break* through its walls; on the contrary, pursue it, make the best of it, succeed in it, do better than others in it, and before long a siding will open from the groove and lead to wider things. Success is largely a matter of patient hope and perseverance; 'all things come round to him who knows to wait.'

Yet, at the same time, remember that success and distinction are terms relative, and that even the groove itself, pursued, will offer success and distinction in the relative sense and degree.

Fourthly, an essential to success is *pre-qualification*. One must qualify beforehand for what opportunities may occur. It is useless to wait till a post is vacant, or a career appears to promise. There was never a successful man yet (except those, the 'silver-spoon' successful, upon whom greatness is thrust,) who did not perceive afar off the coming opportunity and make ready to seize it. To wait idly for the chance means to miss it, for the chance will be seized by some man who has been fore-thoughtful enough to prepare for the chance, long before the possibility of it became a probability.

With these remarks introductory, we clear the stage for those 'coming men' of whom a series of biographies will treat in forthcoming numbers of this magazine. Mainly, no doubt, these 'coming men' will be the distinguished ones of what the editor of the *Infants' Mistress* fitly dubs 'our-world,' the world scholastic and its precincts. The cynical reader may smile at the idea that there can be 'coming men,' owners of future greatness, among ourselves and 'our world.' Yet the men of whom the series in question will treat may shortly—and almost certainly will eventually—change the smile of doubt into the deference due to success. And in 'our world' there is no one who may not, if he choose, become a 'coming man.'

Our first sketch, to appear next month, will be :—
MR. T. A. ORGAN, B.A.,
Clerk to the Law Department, National Union of Teachers.

OUR PUPIL TEACHERS' COURSE.

I. TYPICAL GOVERNMENT QUESTIONS.

A. *English.*

(*a*) *First Year.*

1. Distinguish between *my* and *mine*, and between a Gerund and Participle.

2. Explain voice in verbs, giving illustrative examples.

3. Show by examples that Pronouns admit of more inflections than Nouns.

4. Draw up a table of Prepositions according to the relations they indicate.

5. Give examples of simple, compound, and derivative Prepositions.

6. Give examples of Nouns, (*a*) with no plurals, (*b*) with no singulars, (*c*) with different meanings in the singular and plurals, (*d*) with double plurals, and (*e*) with two plurals.

7. Draw up a table of Adverbs.

8. Give instances of Prepositions used as Adverbs, as Adjectives, and to make Intransitive Verbs Transitive.

9. Mention the three principal ways in which Adjectives qualify.

10. Give instances of Adjectives used in the plural, and of Adjectives used after their Nouns.

11. Write down a list of Adjectives and Adverbs irregularly compared.

12. Decline the Personal and Relative Pronouns.

13. What classes of Adjectives cannot be compared?

14. In what ways is the Gender of Nouns distinguished?

15. Give instances of the word '*that*' used as different 'parts of speech.'

16. Give examples of participial phrases and of words in apposition.

17. Name the most important auxiliary verbs, giving illustrative sentences.

18. Give examples of Verbs that may be used transitively or intransitively.

19. Take the following words to pieces and tell the meaning of each of their parts :—*Homeward*, etc.

20. Give the plural of *dwarf*, *sow*, *prospectus*, *grotto*, etc.

21. Explain the terms Subjunctive Mood, Gerundive, Extended Predicate, Potential, Infinitive, etc.

22. Quote three of the most important rules of Syntax, giving examples.

23. Make sentences in which *for*, *but*, *before*, *until*, *after*, are used first as Prepositions, next as Conjunctions.

24. Make sentences containing, (*a*) An Adverbial Phrase, (*b*) A Demonstrative Adjective, (*c*) An Infinitive of Purpose, and (*d*) a Participal used as a Noun.

(*b*) *Second Year.*

1. Make sentences in which the following words are followed by their idiomatic preposition :—*Prejudice*, *Incumbent*, etc.

2. Define *Inflexion*, giving examples. What substitutes for them do we employ? What 'parts of speech' are inflected and for what purposes?

3. Give a list of eight important Latin and eight English prefixes, exemplifying their meaning and use.

4. Give a list of ten suffixes which show the Latin derivation of words. Explain their meaning and illustrate their use.

5. Give the meaning of each part of the following words :—*Inhabitant*, *Innocuous*, etc.

6. Show the difference between an *Adverb*, an *Adverbial Clause*, and an *Adverbial Phrase*. Add one to the sentence—'*The wind blew*.'

7. How would you explain '*Case*' to your scholars? Give illustrative sentences.

8. Give the different forms of '*ad*' and '*con*' with examples in words.

9. Give examples of Adjective sentences. How may these be known?

10. Name the Interrogative Pronouns, and give instances (where possible) of their substantive and adjectival use.

11. Define '*Person*' in Pronouns. Give the Masculine, Feminine and Neuter Objectives Singular of '*them*.'

12. How many kinds of subordinate sentences are there? Give examples.

13. Draw up a table of Conjunctions (*a*) according to their derivation, (*b*) according to their function.

14. What are the functions of the Objective Case? Give examples of its use.

15. What are Copulative Verbs, Factitive Verbs, Substantive Verbs, Verbs of Incomplete Predication, and Defective Verbs?

16. Mention some words which are (*a*) part Verbs and part Nouns; (*b*) part Verbs and part Adjectives, (*c*) part Adverbs and part Conjunctions, and (*d*) part Nouns and part Adverbs.

17. The Infinitive Mood may be a Noun, an Adjective, or an Adverb. Illustrate this statement.

18. Write down with examples the different ways in which the predication of a Verb may be extended.

19. How many moods are there in English? Define them and give examples of their use.

20. Write out some Negative Adverbs, Negative Pronouns, Negative Adjectives, and Negative Conjunctions.

21. What Conjunction sometimes takes an Objective Case after it?

22. Give instances of '*as*' used as different parts of speech.

23. What three offices does the Nominative Case discharge?

24. Form words which shall begin with one of the following prefixes and close with one of the suffixes :—(*a*) *pre-*, *in-*, *em-*, *syn-*, *contra-*; (*b*) *-tion*, *-ize*, *-en*, *-fy*, *-ate*.

(*c*) *Third Year.*

1. Give instances of prepositional phrases used (*a*) adverbially, (*b*) adjectively.

2. Select the Latin words from the following sentence :— .

3. Correct the following sentences :— . . . . . .

4. What do you know of the origin, formation, and precise meaning of the following words :—*Distributive*, *Extempore*, *Atheist*, *Overweening*, etc.

5. When did Milton, Pope, Cowper, Hume, Coleridge, and Macaulay live? What did they write?

6. Make a list of some common termination of words derived from other languages than Latin, and give examples of each.

7. Give instances of the word '*what*' used as different 'parts of speech.'

8. Explain the terms elliptical, dative, potential, prolative.

9. Who were the principal English poets of the 17th century What did they write?

10. Explain and illustrate these statements:—(*a*) '*Two negatives make an affirmative*; (*b*) '*Relatives must agree with their antecedents*.'

11. How may the subject of a sentence be enlarged? Give examples.

12. What is meant by the Drama? Name six famous English dramatic writers and the names of any of their works.

13. Give the plurals of crisis, cherub, automaton, madam, monsieur, formula, genius, genus.

14. State and illustrate any rules which would help a learner to guard against the misuse of the word '*which*.'

15. Give instances of the various uses of the word '*the*.'

16. What Latin words enter into the present names of any of our towns?

17. What are the commonest faults in paraphrasing, and how may they be avoided?

18. Account for the English vocabulary being composite. Give one word which we have incorporated from each of eight different languages.

19. Account for the inflexion of the possessive case in nouns. What erroneous theory respecting it formerly prevailed?

20. What do you know of the word '*its*'?

21. What are the most common ellipses of our language? Give six examples.

22. Give instances of (*a*) adjectives following their nouns, (*b*) verbs following their objects, (*c*) prepositions following their governed nouns.

23. Give instances where a noun sentence is not contained in any principal sentence.

24. Point out the Celtic or Scandinavian element in the words *Aberdeen*, *Balmoral*, *Pen-maen-Mawr*, *Caer-leon*, *Kilmarnock*, *Whitby*, *Caldbeck*, *Dalby*, *Mickleforce*, *Scawfell*, etc.

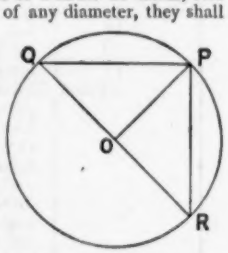
II. HINTS ON LAST MONTH'S WORK.

(*a*) Prove that $\frac{3}{5}$ of a unit = $\frac{1}{5}$ of three units.
$\frac{1}{5}$ of 3 units = $\frac{1}{5}$ of 1 unit + $\frac{1}{5}$ of 1 unit + $\frac{1}{5}$ of 1 unit = $\frac{3}{5}$ of 1 unit.—Q. E. D.

(*b*) His heart is *like* the noble *tree*.
like = adj., posit. degree, qual. *heart* predicatively.
tree = com. noun, sing., 3rd pers., neut., obj. (dative), modifying *like*.

(*c*) *Iberian Peninsula* = *The* Peninsula = Spain and Portugal.

(*d*) If any point in the circumference of a circle be taken, and thence lines be drawn to the extremity of any diameter, they shall contain a right angle.



Let QPR be a circle whose centre is O, P being any point on the circumference, and QR any diameter.
Then QPR is a right angle.
Join PO.
∧ OQP = ∧ OPQ (I. 5) and ∧ ORP = ∧ OPR (I. 5)
∴ ∧s OQP + ORP = ∧ QPR
∴ ∧ QPR is a right angle (I. 32).

(*e*) In connection with the above deduction, the following ones should be studied :—

α The middle point of the hypotenuse of a right angled triangle is equi-distant from the three angles.

β The diagonals of a rectangle are equal and bisect each other.

γ If a ladder sloped against a wall slips away so that its foot describes a perpendicular to the wall, its middle point moves in a circular path.

8 If the side BA of an isoceles triangle BAC be produced to E so that AE = BA or CA, and EC be joined, then ECA is a right angle.

9 If the middle point of the base of an isoceles triangle be joined to the middle points of the sides, the quadrilateral thus formed is a rhombus.

III. Model Answers to Geography Paper (*April* 1893).

GEOGRAPHY.

First Year.—Boys and Girls.

(*Answer three questions only, and include* 6.)

1. Which are the chief commercial rivers of England and Scotland? Show that they are well adapted for commerce; name the towns at their mouths, and the nature of the principal trades in which they are engaged.

	Chief Commercial Rivers.	How they are well adapted for Commerce.	Towns at their mouths.	Principal trades of these towns.
ENGLAND.	*Thames*	Chief waterway across S. England. Nearest important river to continent. Navigable for the largest ships to the heart of London. Flows through flourishing agricultural districts and past large towns.	*London*—Woolwich, Greenwich, &c.	Chiefly an emporium for all trades. The banking capital of the commercial world. Manufactures jewellery, machinery, chemicals and silk, cutlery, woollen and linen goods, &c.
			Gravesend, Rochester, Chatham.	Outlying ports of London.
	Mersey	Chief waterway on W. Coast. Flows through coal and cotton district of Lancashire, and salt district of Cheshire.	*Liverpool*—Birkenhead, Runcorn.	Ship-building, cotton port, large export and import trade with every country in cotton, cattle, fruit, raw and manufactured material, coal, &c.
	Humber: *Ouse.*	Flows through coal and woollen district, and past towns which manufacture cutlery, iron, steel, and brass goods.	*Hull*—Grimsby, Goole.	Large fishing trade, import trade chiefly timber; exports, coal, chemicals, fish, manufactures of central England.
	Humber: *Trent.*	Flows through pottery district (country about Birmingham noted for hardware), past distilleries and past coalfields.		
	Tyne	Flows through very rich coalfield.	*Newcastle*—Gateshead, N. Shields, S. Shields.	Immense coal trade, shipbuilding, chemicals, glass, &c. Large export trade of coal.
SCOTLAND.	*Clyde*	Flows through coal-field; past iron, silk, wool, and cotton factories.	*Glasgow*—Port Glasgow, Greenock, Dumbarton, Renfrew.	Large export and import trade, ship-building, silk, iron, cotton, linen, glass, &c.
	Tweed	Flows through sheep and cattle rearing country, past towns engaged in woollen manufacture.	Berwick.	Exports: Salmon and Tweed cloth.
	Forth	Estuary flows past coal-field and through iron district.	*Edinburgh* (Leith)—Linlithgow. Alloa. Grangemouth. Kirkcaldy.	Printing, paper, glass, soap, distilleries, fishing trade, port for coal and iron, linen, and sail-cloth.
	Tay	Wide estuary flows past towns engaged in linen manufacture, past large dye-works.	*Dundee*—Perth.	Linen, hemp, sail-cloth, preserves, leather.

2. In what districts and towns in Ireland are the raising of live-stock and the manufacture of linen and woollen goods carried on? Account for these industries being thus localised.

The districts of Ireland engaged in the raising of live-stock are the greater part of *Connaught*.

The counties along the middle and lower courses of the Shannon, counties of Wexford and Cork. The chief towns engaged in the live-stock trade are Mullingar, Tullamore, and Ballinasloe. The reason that cattle-rearing is confined to these districts is because in many other parts much land is useless for pastoral purposes, as it is bog-land, (*e.g.*) Bog of Allen, covering large portions of counties Kildare, Westmeath, King's County.

The linen and woollen manufacturers are carried on in the eastern portions of Ulster and the N.E. part of Leinster (Louth and Meath).

Chief towns:—Belfast, Carrickfergus, Lisburn, Newry, Drogheda, Dundalk.

Part of Ulster and Leinster was colonized by *Scottish* and English *merchants* and farmers, who being *more industrious* than the Irish, established these trades, which the Irish have not generally adopted themselves.

3. Trace the course of a wheat-laden ship from Chicago to Montreal, noting the towns on the lakes, and the characteristic features of the river from Lake Ontario to Montreal.

Starting from Chicago, the ship heads for the north through Lake Michigan, and we at length pass Milwaukee on the left shore, a grain port, second in importance to Chicago, and soon after leave behind the rising town of Manitowoc.

Leaving Lake Michigan, we enter Lake Huron, and passing Georgian Bay on our left, this time sailing south-easterly, we pass Port Goderich, the chief Canadian port on Lake Huron, and enter Lake St. Clair, seeing the large manufacturing town of Detroit on our right, and the small town of Chatham on our left.

On leaving Lake St. Clair, we turn in a north-easterly direction and sail through the shallowest of all the Canadian lakes, Lake Erie, passing Cleveland, in Ohio, U.S.A., and shortly afterwards the grain port of Buffalo, in New York. We now enter the Welland Canal—in order to avoid the Falls and Rapids of Niagara—and having safely passed through, find ourselves in the shallow lake of Ontario, we keep to the north coast, still sailing north-easterly, and leave the three towns of Hamilton (a depot for fruit and grain), Toronto (the flourishing capital of Ontario), and Kingston (a town at the head of the Rideau Canal, which goes to Ottawa) behind us, before entering the well-known course of the river St. Lawrence.

The St. Lawrence at this point is about seven miles wide, and as it grows still wider, we find ourselves in the lake of the 1,000 isles, the islands of which are covered with magnificent pine trees; in fact both banks of the river now present a charming appearance, being studded with pine trees, which form the wealth of the population, about Brockville and Prescott, since they are engaged in the lumbering trade. Below these islands the steamer shoots several rapids, amongst others being the Cedars and Lachine Rapids, where an Indian pilot is taken on board to steer us safely through.

When we have gone about 100 miles down the river, we pass the River Ottowa, and gazing up that important affluent, we see numerous rafts floating down the stream. In a little while we pass under the great Victoria Tubular Bridge made by Stephenson, and then unload our cargo in the spacious quays of Montreal, nicely situated with its 160,000 inhabitants under the hill called Mount Royal.

4. Where and what are the following:—Ballarat, Bathurst, the Burdekin, Albany, Flinders' Range, the Great Barrier Reef?

Name.	Situation.	Description.
BALLARAT - -	Is in Victoria (Australia), West of Melbourne.	Famous gold mining town (alluvial).
BATHURST - -	In the Blue Mountains, N. S. W. (Australia), N.W. of Sydney.	In the centre of a large wheat-growing district, and also in the neighbourhood of gold mines.
BURDEKIN - -	In the N.E. part of Queensland (Australia).	Important river. Townsville is at its mouth.
ALBANY - - -	In W. Australia, at the S.W. extremity of King Geo. Sound.	Rising sea-port on fine harbour.
FLINDERS' RANGE.	In S. Australia, E. of Lake Torrens.	Range of mountains.
GREAT BARRIER REEF.	Off the coast of Queensland, Australia.	Is composed of a series of coral reefs, altogether 1,200 m. long.

5. Describe the characteristics of each part of a river which has an upper, a middle, and a lower course.

The *upper course* of a river is generally through a hilly or mountainous country; and is hence the most rapid course. It is here often broken by waterfalls, cataracts, or rapids. This course is not navigable. A lake frequently terminates this part of a river's course and acts as a filter-bed. Thus the Rhone's upper course terminates in Lake Geneva; the Rhine's upper course terminates in Lake Constance. Both enter muddy and come out clear.

(*b*) The *middle course* is frequently over table-land or hilly land. The valley opens out, and the stream itself grows wider, the fall is less, and the current is much slower. Navigation and cultivation on its banks begin.

(*c*) The *lower course* is generally through an almost level country. The body of water is here largest; and it has frequently to be kept within its banks by artificial dams, dykes, levees, etc. Here, too, occur the most numerous and the largest curves, with sandbanks, islands, etc.

N.B.—The river Po is, in its lower course, high above the towns on its banks; and the Mississippi is only kept in by levees from flooding the delta.

6. Draw a map of Scotland.

See any good atlas.

IV. Our Pupil Teachers' Papers will be marked throughout the year and corrections, hints, etc. supplied for half-a-guinea paid in advance. Pupil Teachers may utilise this arrangement at any time. Apply, Dr. G. Beach, M.A., Macclesfield.

(*To be continued.*)

FIRST YEAR.

1. What fraction of 10 miles is $\frac{3}{5}$ of $\frac{5}{9}$ of 18 yards? Ans. $\frac{3}{110}$.

2. If A owns ·58 of a ship, and B owns the rest; and if the difference in the money value of their shares is £37·46, what is the value of the ship? Ans. £234 2s. 6d.

3. Find, by practice, the loss of time in 17 days 9 hours 45 minutes, if a watch loses 8 minutes 16 seconds in 6 hours.

Ans. 575 mins. 34 secs.

4. Write in *Large-hand* the words By-path, Rhyl, Phthisis, Zebra, Queen.

Write in *Small-hand* the words, 'And may there be no sadness of farewell when I embark.'

5. Analyse the subjoined passage, and parse the words indicated:—

'Her crew *had seen* Castile's black fleet
Beyond *Aurigny's* isle,
At *earliest* twilight on the wave,
Lie heaving many a mile,
At sunset she escaped *their* van,
By God's especial grace.'

6. Give examples of collective nouns, passive verbs, participial phrases, nouns in apposition.

7. Describe the character of the Anglo-Saxons.

8. Draw a map of Scotland.

9. In what districts and towns in Ireland are the raising of live stock and the manufacture of linen and woollen goods carried on? Account for these industries being thus localised.

10. Show briefly how the Roman Conquest differed in its effects from the Saxon Conquest.

11. What led to the battle of Stamford Bridge? Give a short account of the contest.

12. What are the advantages and disadvantages of simultaneous reading?

13. Write the signatures and scales (using semibreves) of F and G major in the treble and bass clefs; OR

What other groups of contiguous scale tones are separated by the same interval steps as the following?

(*a*) (*b*) (*c*)

m f s l ‖ s l t d' ‖ r m f s

14. Write out three of the principal rules of Syntax in Latin or French, giving examples.

15. Give fully the perfect indicative and present subjunctive of *esse* or *être*.

SECOND YEAR.

1. If the work done by a man, a woman, and a boy be in the proportion of 3, 2, 1, and if 12 men, 15 women, and 15 boys can complete a certain work in 270 days, in what time would 18 men, 12 women, and 12 boys complete it? Ans. 243 days.

2. Reduce $\{(\frac{3}{7}$ of $5\frac{1}{4}) + (1\frac{5}{6}$ of $10\frac{2}{7})\} \div 10\frac{1}{2}$ to a simple fraction in its lowest terms. Ans. $1\frac{1}{7}$.

3. Reduce $\frac{3}{7}$, $\frac{10}{11}$, $\frac{7}{100}$, $\frac{11}{250}$ to decimal fractions; and explain why the first three produce recurring fractions.

Ans. ·428571; 1·72; ·07; ·044.

4. As in First Year.

5. Paraphrase:—

'Not wholly in the busy world, nor quite
Beyond it, blooms the garden that I love.
News from the humming city comes to it
In sound of funeral or of marriage bells:
And sitting muffled in dark leaves, you hear
The windy clanging of the minster clock;
Although between it and the garden lies
A league of grass, washed by a slow broad stream,
That stirred with languid pulses of the oar
Waves all its lazy lilies, and creeps on
Barge-laden to three arches of a bridge
Crowned with the minster tower.'—*Tennyson.*

6. Cite three of the most important rules of Syntax, and give sentences illustrating their use.

7. Write what you can about the condition of England in Stephen's reign.

8. Enumerate the productions of Australia and New Zealand, noting the colony or district where they are severally produced.

8 If the side BA of an isoceles triangle BAC be produced to E so that AE = BA or CA, and EC be joined, then ECA is a right angle.

9 If the middle point of the base of an isoceles triangle be joined to the middle points of the sides, the quadrilateral thus formed is a rhombus.

III. Model Answers to Geography Paper (*April* 1893).

GEOGRAPHY.

First Year.—Boys and Girls.

(*Answer three questions only, and include* 6.)

1. Which are the chief commercial rivers of England and Scotland? Show that they are well adapted for commerce; name the towns at their mouths, and the nature of the principal trades in which they are engaged.

	Chief Commercial Rivers.	How they are well adapted for Commerce.	Towns at their mouths.	Principal trades of these towns.
ENGLAND.	*Thames*	Chief waterway across S. England. Nearest important river to continent. Navigable for the largest ships to the heart of London. Flows through flourishing agricultural districts and past large towns.	*London*—Woolwich, Greenwich, &c.	Chiefly an emporium for all trades. The banking capital of the commercial world. Manufactures jewellery, machinery, chemicals and silk, cutlery, woollen and linen goods, &c.
			Gravesend, Rochester, Chatham.	Outlying ports of London.
	Mersey	Chief waterway on W. Coast. Flows through coal and cotton district of Lancashire, and salt district of Cheshire.	*Liverpool*—Birkenhead, Runcorn.	Ship-building, cotton port, large export and import trade with every country in cotton, cattle, fruit, raw and manufactured material, coal, &c.
	Humber: *Ouse*	Flows through coal and woollen district, and past towns which manufacture cutlery, iron, steel, and brass goods.	*Hull*—Grimsby, Goole.	Large fishing trade, import trade chiefly timber; exports, coal, chemicals, fish, manufactures of central England.
	Humber: *Trent*	Flows through pottery district (country about Birmingham noted for hardware), past distilleries and past coalfields.		
	Tyne	Flows through very rich coalfield.	*Newcastle*—Gateshead, N. Shields, S. Shields.	Immense coal trade, shipbuilding, chemicals, glass, &c. Large export trade of coal.
SCOTLAND.	*Clyde*	Flows through coal-field; past iron, silk, wool, and cotton factories.	*Glasgow*—Port Glasgow, Greenock, Dumbarton, Renfrew.	Large export and import trade, ship-building, silk, iron, cotton, linen, glass, &c.
	Tweed	Flows through sheep and cattle rearing country, past towns engaged in woollen manufacture.	Berwick.	Exports: Salmon and Tweed cloth.
	Forth	Estuary flows past coal-field and through iron district.	*Edinburgh* (Leith)—Linlithgow. Alloa. Grangemouth. Kirkcaldy.	Printing, paper, glass, soap, distilleries, fishing trade, port for coal and iron, linen, and sail-cloth.
	Tay	Wide estuary flows past towns engaged in linen manufacture, past large dye-works.	*Dundee*—Perth.	Linen, hemp, sail-cloth, preserves, leather.

2. In what districts and towns in Ireland are the raising of live-stock and the manufacture of linen and woollen goods carried on? Account for these industries being thus localised.

The districts of Ireland engaged in the raising of live-stock are the greater part of *Connaught*.

The counties along the middle and lower courses of the Shannon, counties of Wexford and Cork. The chief towns engaged in the live-stock trade are Mullingar, Tullamore, and Ballinasloe. The reason that cattle-rearing is confined to these districts is because in many other parts much land is useless for pastoral purposes, as it is bog-land, (*e.g.*) Bog of Allen, covering large portions of counties Kildare, Westmeath, King's County.

The linen and woollen manufacturers are carried on in the eastern portions of Ulster and the N.E. part of Leinster (Louth and Meath).

Chief towns:—Belfast, Carrickfergus, Lisburn, Newry, Drogheda, Dundalk.

Part of Ulster and Leinster was colonized by *Scottish* and English *merchants* and farmers, who being *more industrious* than the Irish, established these trades, which the Irish have not generally adopted themselves.

3. Trace the course of a wheat-laden ship from Chicago to Montreal, noting the towns on the lakes, and the characteristic features of the river from Lake Ontario to Montreal.

Starting from Chicago, the ship heads for the north through Lake Michigan, and we at length pass Milwaukee on the left shore, a grain port, second in importance to Chicago, and soon after leave behind the rising town of Manitowoc.

Leaving Lake Michigan, we enter Lake Huron, and passing Georgian Bay on our left, this time sailing south-easterly, we pass Port Goderich, the chief Canadian port on Lake Huron, and enter Lake St. Clair, seeing the large manufacturing town of Detroit on our right, and the small town of Chatham on our left.

On leaving Lake St. Clair, we turn in a north-easterly direction and sail through the shallowest of all the Canadian lakes, Lake Erie, passing Cleveland, in Ohio, U.S.A., and shortly afterwards the grain port of Buffalo, in New York. We now enter the Welland Canal—in order to avoid the Falls and Rapids of Niagara—and having safely passed through, find ourselves in the shallow lake of Ontario, we keep to the north coast, still sailing north-easterly, and leave the three towns of Hamilton (a depot for fruit and grain), Toronto (the flourishing capital of Ontario), and Kingston (a town at the head of the Rideau Canal, which goes to Ottawa) behind us, before entering the well-known course of the river St. Lawrence.

The St. Lawrence at this point is about seven miles wide, and as it grows still wider, we find ourselves in the lake of the 1,000 isles, the islands of which are covered with magnificent pine trees; in fact both banks of the river now present a charming appearance, being studded with pine trees, which form the wealth of the population, about Brockville and Prescott, since they are engaged in the lumbering trade. Below these islands the steamer shoots several rapids, amongst others being the Cedars and Lachine Rapids, where an Indian pilot is taken on board to steer us safely through.

When we have gone about 100 miles down the river, we pass the River Ottowa, and gazing up that important affluent, we see numerous rafts floating down the stream. In a little while we pass under the great Victoria Tubular Bridge made by Stephenson, and then unload our cargo in the spacious quays of Montreal, nicely situated with its 160,000 inhabitants under the hill called Mount Royal.

4. Where and what are the following:—Ballarat, Bathurst, the Burdekin, Albany, Flinders' Range, the Great Barrier Reef?

Name.	Situation.	Description.
BALLARAT - -	Is in Victoria (Australia), West of Melbourne.	Famous gold mining town (alluvial).
BATHURST - -	In the Blue Mountains, N. S. W. (Australia), N.W. of Sydney.	In the centre of a large wheat-growing district, and also in the neighbourhood of gold mines.
BURDEKIN - -	In the N.E. part of Queensland (Australia).	Important river. Townsville is at its mouth.
ALBANY - - -	In W. Australia, at the S.W. extremity of King Geo. Sound.	Rising sea-port on fine harbour.
FLINDERS' RANGE.	In S. Australia, E. of Lake Torrens.	Range of mountains.
GREAT BARRIER REEF.	Off the coast of Queensland, Australia.	Is composed of a series of coral reefs, altogether 1,200 m. long.

5. Describe the characteristics of each part of a river which has an upper, a middle, and a lower course.

The *upper course* of a river is generally through a hilly or mountainous country; and is hence the most rapid course. It is here often broken by waterfalls, cataracts, or rapids. This course is not navigable. A lake frequently terminates this part of a river's course and acts as a filter-bed. Thus the Rhone's upper course terminates in Lake Geneva; the Rhine's upper course terminates in Lake Constance. Both enter muddy and come out clear.

(*b*) The *middle course* is frequently over table-land or hilly land. The valley opens out, and the stream itself grows wider, the fall is less, and the current is much slower. Navigation and cultivation on its banks begin.

(*c*) The *lower course* is generally through an almost level country. The body of water is here largest; and it has frequently to be kept within its banks by artificial dams, dykes, levees, etc. Here, too, occur the most numerous and the largest curves, with sandbanks, islands, etc.

N.B.—The river Po is, in its lower course, high above the towns on its banks; and the Mississippi is only kept in by levees from flooding the delta.

6. Draw a map of Scotland.

See any good atlas.

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(To be continued.)

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Ans. 575 mins. 34 secs.

4. Write in *Large-hand* the words By-path, Rhyl, Phthisis, Zebra, Queen.

Write in *Small-hand* the words, 'And may there be no sadness of farewell when I embark.'

5. Analyse the subjoined passage, and parse the words indicated:—

'Her crew *had seen* Castile's black fleet
Beyond *Aurigny's* isle,
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Lie heaving many a *mile*,
At sunset she escaped *their* van,
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(*a*) (*b*) (*c*)

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14. Write out three of the principal rules of Syntax in Latin or French, giving examples.

15. Give fully the perfect indicative and present subjunctive of *esse* or *être*.

SECOND YEAR.

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2. Reduce $\{(\frac{3}{4}$ of $5\frac{1}{2}) + (1\frac{5}{8}$ of $10\frac{2}{7})\} \div 10\frac{3}{7}$ to a simple fraction in its lowest terms. Ans. $1\frac{1}{2}$.

3. Reduce $\frac{3}{7}$, $\frac{18}{41}$, $\frac{7}{990}$, $\frac{11}{1250}$ to decimal fractions; and explain why the first three produce recurring fractions.

Ans. $\cdot\dot{4}28571$; $1\cdot\dot{7}\dot{2}$; $\cdot0\dot{7}$; $\cdot044$.

4. As in First Year.

5. Paraphrase:—

'Not wholly in the busy world, nor quite
Beyond it, blooms the garden that I love.
News from the humming city comes to it
In sound of funeral or of marriage bells:
And sitting muffled in dark leaves, you hear
The windy clanging of the minster clock;
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A league of grass, washed by a slow broad stream,
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Waves all its lazy lilies, and creeps on
Barge-laden to three arches of a bridge
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8. Enumerate the productions of Australia and New Zealand, noting the colony or district where they are severally produced.

PUPIL TEACHERS' ROUTINE FOR AUGUST 1893.

DAYS	YEARS	FIRST WEEK			SECOND WEEK			THIRD WEEK			FOURTH WEEK		
		First Lesson	Second Lesson	Third Lesson	First Lesson	Second Lesson	Third Lesson	First Lesson	Second Lesson	Third Lesson	First Lesson	Second Lesson	Third Lesson
MONDAY	1	Analysis and Parsing *or* Latin	How to teach Reading	Div. of Decimals. Simple Practice	Analysis *or* Paraphrasing from Routine	How to teach Writing	Map of Chief British Rivers	Analysis and Parsing	How to teach Arithmetic	Physical Geog. of Mountains and Rivers	Composition or Paraphrasing	Lives of Great Men	Geography of England
	2			Stocks. Reduc. of Vulgar Fractions			Map of Spanish Peninsula.			Latitude and Longitude			Climates of British Empire
	3		How to give an Object Lesson	Mens. of Parallelograms. Theory of required rules		Notes of an Arithmetic Lesson	Map of Mediterranean Sea		Notes of a Lesson on Form	Winds and Ocean Currents			Geography of Africa
TUESDAY	1	Euclid I. 9. Knitting Sock	Literature, Repetition, and Writing	Scripture *or* Revision	Euclid I. 10, 11. Paper Patterns of Garments	Composition or Paraphrasing	Scripture *or* Revision	Euclid I. 12. Practise Stitches	Instrumental Music *or* Literature	Scripture *or* Revision	Euclid I. 13. Practise Stitches	Literature, Repetition, and Writing	Scripture *or* Revision
	2	Euclid I. 15, 16. Any Needlework			Euclid I. 17, 19. Flannel Patch.			Euclid I. 23, 26. Practise Stitches			Euclid Revision. Practise Stitches		
	3	Euclid I. 46, 47. Cross-cut Darn			Euclid I. 47, 48. Any Needlework			Euclid Deductions. Any Needlework			Euclid Deductions. Any Needlework		
WEDNESDAY	1	Dates from 1035 to 1066 A.D.	Div. of Algebra. Practise Stitches	Euclid Deductions	History from Canute to the Confessor	Literature, Repetition, and Writing	Euclid Deductions	History from 1042 to 1066 A.D.	Multiplication of Algebra. Knitting Sock	Euclid Deductions	Anglo-Saxon Literature and Remains	Division of Algebra Any Geography	Euclid Deductions
	2	History from 1461 to 1473 A.D.	G.C.M. of Algebra Practise Stitches		Dates from 1422 to 1478 A.D.			History from 1478 to 1485 A.D.	Revise Euclid. Knitting Stocking		Revise Literature from 1066 to 1485 A.D.	Division of Algebra Any Geography	
	3	History from 1649 to 1688 A.D.	Problems in Algebra. Any Needlework		Lives of Great Men.			Literature from Elizabeth to James II.	Revise Euclid. Cross-cut Darns		Revise Dates	Any Mensuration. Any Needlework.	
THURSDAY	1	Geography of Ireland	English from Text Book	Div. of Algebra. Stocking-hole mending	Geography of Ireland	Lives of Great Historic Persons	Proofs of Algebraical operations *or* Domestic Economy	Geography of Ireland	Prefixes, Roots, or Affixes	Circult. Decimals. Problems in Vulgar Fractions	Geography of British North America	Mensuration *or* Domestic Economy	Map of Irish Sea
	2	Geography of India		Euclid I. 20, 23. Print Patch.	Productions of British Empire			Geography of India		Any Vulgar Fractions. Miscellaneous Problems	Geography of India		Map of Italy
	3	Geography of Asia		Revision of Euclid. Hedge-tear Darns	Geography of Asia			Geography of Africa		Miscellaneous Problems.	Geography of Asia		Map of South Africa
FRIDAY	1	Div. of Decimals Easy Multip. of Vulgar Fractions	Drawing	Practical Music	Decimals of Money. Simple Proportion	Drawing	Mensuration *or* Sewing	Dec. of Weights & Measures. Probs. in Vulgar Fractions	Drawing	Theoretical Music	Any Decimal Fractions. Misc. Problems	Drawing	Mensuration *or* Sewing
	2	Stocks, Money Decimals			Com. Proportion. Reduc. of Decimal Fractions			Com. Proportion. Vulgar Fractions of Weights			Miscellaneous Problems		
	3	Mens. of Parallelograms. Proofs of the required rules			Miscellaneous Problems			Miscellaneous Problems			Geography of Australia		
SATURDAY	1	French *or* Latin	Science	Examination (See appended Questions)	French *or* Latin	Science	Examination (See appended Questions)	French *or* Latin	Science	Examination (See appended Questions)	French *or* Latin	Science	Examination (See appended Questions)
	2												
	3												

9. What are the chief exports of Hindostan? What goods does it import from us?

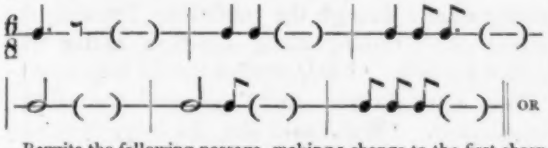
10. William I. may be described as a great and wise though a cruel sovereign. Cite facts to support this statement.

11. Give an account of Jack Cade's rebellion.

12. Write out Euclid I. 26.
Draw a diagram showing that the equal sides must be similarly situated.
Write out recipes for a rice pudding, barley-water, and an Irish stew.

13. Write out Notes of a Lesson on Punctuation to Standard V.

14. Complete each bar of the following by adding one note or rest :—



OR

Rewrite the following passage, making a change to the first sharp key at the fourth note from the start and returning to the original key at the fourth note from end :—

m s d m fe l r s fe s f t, d.

15. Write out the Latin *or* French cardinal and ordinal numerals from nought to twenty.

16. Give the days of the week, months of the year, and the seasons, in French *or* Latin.

THIRD YEAR.

1. (*a*) 66·761 divided by one-half of ·1322. Ans. 1010.
(*b*) ·094 divided by ·0042 correctly to three places of decimals. Ans. 22·381 nearly.

2. A circular race path is 1078 yards round, A and B start back to back to run round it. The one runs at the rate of 12, and the other at 12½ miles per hour. When and where will they first meet. Ans. 1½ mins. ; 528 and 550 yds. from start.

3. In a certain examination every candidate was allowed to take either the Language Paper, or the Science Paper, or both. 75·6 p.c. took the Language Paper ; 87·4 p.c. took the Science Paper. There were 1700 candidates. How many took both papers? Ans. 1071.

4. As in First Year.

5. Paraphrase :—

'Join voices, all ye living souls : ye birds
That singing up to Heaven's gate ascend,
Bear on your wings and in your notes His praise.
Ye that in waters glide, and ye that walk
The earth, and stately tread or lowly creep,
Witness if I be silent, morn or even,
To hill or valley, fountain or fresh shade,
Made vocal by my song, and taught His praise.
Hail ! universal Lord, be bounteous still
To give us only good ; and if the night
Have gathered ought of evil or concealed
Desperse it, as now light dispels the dark.—*Milton.*

6. Give two examples each of Noun, Adjective, and Adverbial sentences. Say also when a phrase beginning with a preposition is adverbial, and when adjectival, and give instances.

7. Sketch out the plot of any novel you have read?

8. Cite as many examples as you can, verifying the statements of the following passage :—'*Asia throws out large offshoots on two of its sides ; the gulfs which penetrate it are all the more valuable for commerce, inasmuch as great rivers flow into them.*'

9. What is known respecting the size and population of China? Give the names and position of its six largest towns, and say what you can of each of them.

10. When did the Commons revive the Right of Impeachment? Name in order any impeachments from 1485 to 1688.

11. What revolts occurred in Edward VI.'s reign? What brought them about?

12. Define a *postulate*, an *axiom*, and a *theorem*. Write out the last problem of Euclid, Book I.
What are the advantages and disadvantages of leather, silk, wool, and cotton as clothing materials?

13. What methods would you adopt for first lessons in English History?

14. Resolve into factors :—
$3a^2+23a+14$; $c^2-a^2-b^2+2ab$; $(3a+2b+c)^2-(a+2b+3c)^2$.
Ans. $(3a+2)(a+7)$; $(c+a-b)(c-a+b)$; $8(a+b+c)(a-c)$.

15. The sides of a rectangular piece of ground are in the ratio of 2 to 3, and its area is 156 acres 1½ sq. poles. Find the sides.
Ans. 4 furls. 33¾ poles, 3 furls. 9 poles.

16. Write both in treble and bass clefs the signatures of the following *minor* keys :—C, G, D, E, OR,
Give an example of an augmented fifth, an augmented second, an augmented fourth, from the following form of the minor scale :
l t d r m f se l.

17. Give the principal compounds of *co* and *fero*, *or*, Form adverbs from *aveugle*, *prudent*, *obligeant*, *véhément*, *courageux*, and *bon*.

18. Explain the term *accusative* and name the Prepositions in Latin which govern this case, OR,
Write out, giving examples, ten different meanings of the verb *faire*.

For Correspondence see end of Certificate Article.

NEW COMPOSITION STORIES.—STANDARD V.

Suitable for 'Unseen Tests' in Reading also.

82.

He Took the Clock, but not the Hint.—A well-known professor of a certain college, sometimes became so much interested in his lecture that when the noon bell rang he kept the class five or ten minutes over the hour. Certain restless spirits in his class once thought they would give the professor a gentle hint, so they bought a small alarm clock, set it to go off precisely at noon, and placed it on the professor's desk when they came into the next lecture. They knew that he was a little absent minded, and expected that he would not notice it. As the noon hour struck the alarm went off with a rattling crash, and those of the class not in the secret started and took in the joke at once. There was a round of applause. The professor waited until the alarm and the applause were over, and then said deliberately: 'Young gentlemen, I thank you for this little gift. I had forgotten that it was my birthday. A clock is something my wife has needed in the kitchen for some time. It is a very kind remembrance on your part.' The professor then went on with his lecture and it was ten minutes later than usual when he dismissed the class. He also took the clock home with him, and the young gentlemen never knew whether he understood the hint or not ; the probability is that he did.

83.

The Results of Obedience.—A pointsman in Prussia was on duty in his cabin, and his little boy was playing outside. The railway was a single line, and two trains were coming in opposite directions. The man was just seizing the levers to move the points so as to turn one train into a siding while the other dashed past, when he was horrified to see

his child playing on the line right in front of the approaching train. If he stayed to move the points, his child would be killed; if he left them, and ran out to save it, there would be a collision, and many lives would be lost. He put the points right, and then shouted out to the boy as loud as possible, 'Lie down.' The little one, who had been trained to prompt obedience, instantly did so, and the train rushed up and passed over him. We may imagine what was the father's joy when he rushed down and found his darling quite safe and smiling. Its obedience had saved its life.

84.

Where There's a Will There's a Way.—A small boy, anxious to help support his widowed mother, applied for a position as errand boy in the shop of a fishmonger. 'No,' said the man, 'I want a boy strong enough to carry a bushel of oysters on his shoulder. You are too small to do that.' 'Yes,' answered the boy, 'but I can go twice.' The ready answer carried the day. The boy got the place, and with it a good start in the world.

85.

A Bird's Game.—To show how that set games are played by animals, a lady mentions a curious incident witnessed by her at her house on the Quantock hills. Looking one day from a window into a court yard that was remote from any disturbance, she there saw a robin dragging what seemed the dead body of another robin, round and round in a circle, on the paved court. After continuing this strange proceeding several times, he stopped suddenly, and as suddenly threw himself on his back as if stark dead, with half stretched wings and stiff upturned legs. Meanwhile the other robin woke up to full life, and seizing upon his companion dragged him, in his turn, repeatedly round and round the circle. At the end of the game both birds flew off together to the neighbouring trees.

86.

Strange Story of a Bible.—During the last Zulu war, a soldier was struck in the chest by a bullet. Tearing open his blood-stained coat, and with a tender look, he placed a small Bible in a comrade's hand. However, he recovered, but only to find his comrade's name off the roll. Three years afterwards, entering a canteen in Cape Town, he saw a drunken negro, who had a little book strung round his neck by a strip of snakeskin. The soldier opened the book, and recognised his treasured Bible, with the words, 'from Mother,' still legible. A sum of money readily purchased it from the negro.

87.

A Naughty Boy's Trick.—The danger cord which runs along the side of passenger trains as a safeguard against outrage or accident was lately put to a novel use. A certain old lady on one of the Brighton trains spied the cord, and asked a boy who happened to be on the platform what it was. 'That, ma'am,' said he, with a wicked twinkle in his eye, 'is to ring the bell when you want anything to eat. Then the waiter comes.' After the train had proceeded some distance, the old lady, reaching up to the bell, gave it a vigorous pull. The brakes were applied, the windows thrown up, questions asked, the old lady sitting calmly through the confusion. Presently the guard came rushing along the line, asking who pulled the bell. 'I did,' replied the old lady meekly. 'Well, what do you want?' snapped the official, impatiently. 'Well,' said the old lady, 'you may bring me some ham sandwiches and a bottle of lemonade!'

88.

In Too Great a Hurry.—A very eminent physician had cured a little child from a dangerous illness. The thankful mother turned her steps towards the house of her son's saviour. 'Doctor,' she said, 'there are some services which cannot be repaid. I do not know how to express my gratitude. I thought you would, perhaps, be so kind as to accept this purse, embroidered by my own hands.' 'Madam,' replied the doctor, roughly, 'medicine is no trivial affair, and our visits are only to be rewarded in money. Small presents serve to sustain friendships, but they do not sustain our families.' 'But, doctor,' said the lady, alarmed and wounded, 'speak—tell me the fee.' 'Two thousand francs, madam.' The lady opened her purse, took out five bank notes of one thousand francs each, gave two to the doctor, put the remaining three back in her purse, bowed coldly, and departed.

89.

A Novel Protector.—An elephant, belonging to an English garrison in the Indies, was amusing himself with a chain in an open part of the town, when a man, who had committed a theft, and was pursued by a great number of people, despairing of all other means of safety, ran under the elephant. Apparently delighted with the poor man's confidence, the creature instantly faced about. Erecting his trunk, he threw his chain in the air, and became so furious in defence of the criminal, that notwithstanding the gentle arts made use of by the surrounding multitude, neither they nor even his driver, to whom he was fondly attached, and who was sent for to manage him, could prevail with him to give up the thief. After three hours' contest, the governor heard of this strange rebellion, and came to the scene of the struggle. He was so much pleased with the generous perseverance of the honest creature, that he pardoned the man, who, in an ecstasy of gratitude, testified his acknowledg-

ment by kissing and embracing the trunk of his kind benefactor. The elephant was apparently so sensible of what had happened, that laying aside all his former violence, he became perfectly tame and gentle in an instant, and suffered his keeper to conduct him away without the least resistance.

NEW READING TESTS.—STANDARD III.

Suitable for 'Unseen Tests' in Dictation also.

73.—Few dogs, however brave, can conquer a full-grown male otter in fair fight. If they come up with it in the water and attempt to grapple with it, it is certain to turn quickly and seize them by the nose, and no dog, save highly trained ones, can endure such terrible torture as this. When hunted down on the river bank and brought to bay, the combat generally ends by the spear of one of the hunters.

74.—It frequently happens that a tigress, when she has very little cubs, becomes so cunning that it is impossible either to shoot, trap, or net her, so the only means left to put a stop to her cattle-killing is by poisoning the carcase of the last animal killed. This may seem an easy matter, but it requires a great deal of management, and is not unattended with danger.

75.—He was safe; and guiding himself slowly along with one hand towards the lamb, with the other he lifted it out of its dangerous position, and then tying its four legs together with the halter, he slung the little creature about his neck, and retraced his steps by the way he had come, till, with a feeling of triumph, he landed again beside Jim and the old man.—(H.M.I.'s TEST.)

76.—The dolphin is said to be the fastest swimmer in the seas. It has been observed to dart through the waters at a rate decidedly greater than 20 miles an hour, and it is often seen swimming round and round a vessel which is sailing at its highest speed.

77.—The otter is about three feet four inches in length, from the nose to the tip of the tail; it has a long, low body, short limbs with broad feet, the five toes being connected with a web and armed with short curved claws. The eyes are small and black; the ears very small and rounded; the tail long, broad, and strong at the base. The fur is of two kinds.

78.—The knowledge of time by birds and animals is very curious. How soon the dog finds out which day is Sunday, and never thinks of going with his master to church. He also finds out the time for his master to come home, and begins to be restless as soon as the hour draws near. Birds too know the time, and long before their food is scattered for them, may be seen waiting for it.

79.—Oh, fair beneath the summer sky,
All in the golden light,
The blue waves like a mirror lie,
So peaceful, calm, and bright.
And little feet run here and there
O'er beach and yellow sand,
And children's hearts are happy where
The billows kiss the land.

—(H.M.I.'s TEST.)

NEW DICTATION TESTS.—STANDARD IV.

Suitable for 'Unseen Tests' in Reading also.

11.

Truly great men are polite by instinct to their inferiors. It is one element of their greatness to be thoughtful for others. The greatest men in the world have been noted for their politeness. Indeed, many have owed their greatness mainly to their popular manners, which induced the people whom they pleased to give them an opportunity to show their power.

12.

A close observer of the habits of bees may forecast the weather with constant success. On the approach of a storm they hurry homeward, though the heavens may seem clear and rainless. If in the morning they leave home with a strong flight, and do not return soon, it is a clear sign the day will be fine, for if bad weather were at hand the bees would remain near their own home.

13.

The torpedo boat is cigar-shaped, and is driven by twin screws worked by electric power, and is fitted with complete torpedo gear. It is steered from a little tower in the centre, from which the captain has an all-round view by means of mirrors. Four other men are needed to manage her, but there is accommodation for fifty. The depth inside is just enough to enable a man to stand upright. A torpedo boat on one occasion remained three-quarters of an hour below water, steaming at the rate of six knots an hour.

14.

It is said that a lobster, when left high and dry among the rocks, has not instinct and energy enough to work his way back to the sea, but waits for the sea to come to him. If it does not come, he remains where he is and dies, although the slightest effort would enable him to reach the waves, which are, perhaps, tossing and tumbling within a yard of him. The world is full of human lobsters—men stranded on the rocks of business, who, instead of putting forth their own energies, are waiting for some grand billow of good fortune to set them afloat.

15.

Suddenly the command is given to retire, and, as victors shouting triumph, they march from the field. Then appears upon the scene a horde of wild-looking creatures, running and leaping from place to place, screaming, and frantically beating the earth with thick, heavy clubs. These are the women, and they are engaged in the horrible atrocity of killing the wounded. After a sham fight, the night is spent in feasting and revelry.—(H.M.I's Test.)

STANDARDS V.–VII.

1.

It has been frequently said that after all there is no city in the world like London, and we usually give a nod of assent without so much as a moment's thought of the matter. From time to time, however, the fact is borne in upon us in a way too striking to be so callously passed over. The London General Omnibus Company are the latest to give a hitch to our lagging consciousness. It seems that in the last six months of 1889 eight hundred and thirty vehicles belonging to the Company carried fifty-three and a half million passengers, or close upon three hundred thousand a day!

2.

Universal education cannot fail to prove a most potent lever in the hands of temperance workers. It will develop the stunted intelligence of the lower labouring classes—the classes that are now the most regular and wretched patrons of the public-house, and enable them to recognize their own degradation. Education will beget new tastes and destroy old ones. It will show a man that the feverish tumult of the bar-room is not so good a thing as the decent quiet of the reading-room or library. And as men become masters of themselves, as they see their own divinity, and awaken to new possibilities, crime will diminish.

3.

The King of Siam is said to have in one of his country places a wonderful pavilion. It was built by a Chinese engineer as a refuge for the king during the extreme heat of the summer. The walls, ceilings, and floors are formed of pieces of plate glass an inch thick. They are so perfectly fitted together with a transparent cement that the joints are invisible, and no fluid can penetrate. The pavilion is twenty-eight feet long, seventeen wide, and stands in the middle of a huge basin made of beautifully coloured marbles. When the king enters the pavilion the single door is closed and cemented.

4.

During long and tedious railway journeys taken in the day-time, one is scarcely to be blamed for killing time with a book or paper; but for the attempt to read at night in dimly-lighted carriages, as many do, there is no excuse, and if the habit is persisted in, the result is impairment of the sight, if not some serious disease of the eyes. During the day, in rapidly moving trains, the light is constantly changing, and they roll so unevenly that it is difficult for a person reading to hold the book or paper steadily. The result is that the muscles of the eyes are constantly strained and become weakened.

5.

The great affliction which has befallen the Royal Family has sent a thrill of sorrow through the length and breadth of the Empire. The young life which has been so suddenly snatched away stood to us all in such a peculiar position, that without any exaggeration it may be said that the death of the Duke of Clarence and Avondale will affect the whole future history of our country. As standing in the line of direct succession to the Throne, and as the future Sovereign of these realms, if nature had run its ordinary course, the young prince was marked out, in the national eye, from all others, and was, in a very special way, an object of universal love and solicitude.—(H.M.I.'s Test.)

6.

Work, either of the muscles or the brain, is one of the conditions of human happiness. Without it there can be no wholesome enjoyment. The idle man either seeks a substitute for the healthy excitement of labour in vicious indulgence, or degenerates into a being only a few degrees above the lower animals. His soul and mind, in the one case, become degraded and debased by false uses; in the other, they rust within him, and he is left to the government of the mere instincts which he possesses in common with the brute.

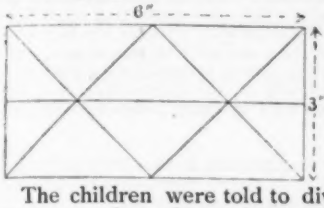
7.

There are various sounds in nature all plaintive and sad; the voice of the winds, the chime of waves, and the song of birds, are all in the minor key, as if all creation groaned and travailed in pain, waiting for that grand deliverance, which is the burden of prophecies, when the great Composer shall transpose all her strains from the minor into the major, and the wild wail of nature shall give way to the glad harmony of the everlasting jubilee, the joyous strains of which shall reverberate from heaven to earth, and the wide universe be as a whispering gallery, ever repeating sweet music.

A RECENT DRAWING EXAMINATION IN A COUNTRY SCHOOL IN YORKSHIRE.

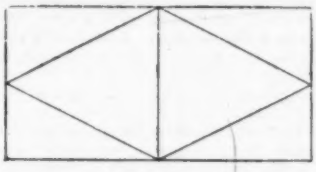
STANDARDS 1 and 2.

THE Inspector asked the teacher to draw the following figure on the blackboard, viz., an oblong, 6 inches by 3, showing its construction line by line. The sides to be all bisected, and lines drawn to the points of bi-section as below.



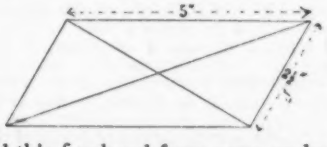
The children were told to divide their slates and papers, and to draw (freehand) the figure in the upper half. The rulers were then given out, and the same figure had to be drawn in the lower half of papers, to measure. Questions were asked on the angles.

Some in Standard 2 did this, freehand, as large as the paper would take in.

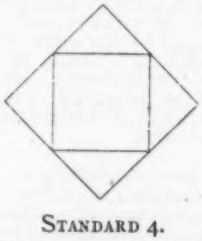


STANDARD 3.

The following figure was on a large paper, and had to be copied, first, freehand, in the upper half of paper, and then with rulers in the lower half.

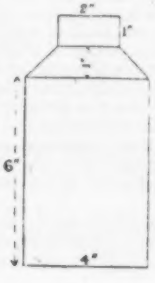


Some did this freehand from copy on board.

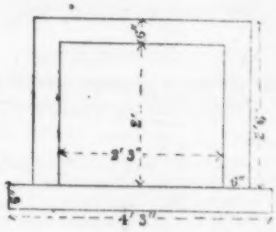


STANDARD 4.

Some had this on squared paper, four squares to one inch.



One had this on card, to draw on plain paper. Scale 1 inch to 1 foot.



One had this to do as large as paper would hold.

One had to draw a pump from card, and to make it twice the size of copy.

Another card was this.

ANSWERS TO QUESTIONS IN ADVANCED PHYSIOGRAPHY.

MAY EXAMINATION, 1893.

BY R. A. GREGORY, F.R.A.S.,

Oxford University Extension Lecturer, Author of 'Elementary Physiography,' 'Physical and Astronomical Geography,' &c.

THE following questions are from the Physiography Examination Paper set in May, and refer to the Advanced Stage. Students should always remember, however, that it is a waste of time to write out each question before answering it. It is quite sufficient to put the number of the question before the answer.

21. According to the almanacs the time of sunset from December 7 to December 13 is constant, while the time of sunrise during the same period varies by ten minutes. Why is this?

The variation is due to the difference between mean time, that is, the time given in almanacs, and true or apparent solar time. Between the dates mentioned, the equation of time is *negative* and diminishing; in other words, a less amount has to be subtracted from apparent time every day in order to convert it into mean time. But at the same time, the sun sets earlier every day owing to its increasing southern declination. And since the loss due to the former cause is approximately equal to the gain due to the latter, the mean time of sunset remains constant. Taking the case of sunrise, and counting from noon in mean time, we still have the equation of time negative and diminishing, while the sun rises later every day owing to its increasing southern declination. Both the corrections to be applied to the mean-time interval from noon to sunrise are therefore negative, whereas, in the case of sunset, one is positive and the other negative. On this account, the mean time of sunset is practically constant, while that of sunrise varies by ten minutes.

22. Contrast the spectra of stars with those of comets.

Similarities.

(1) Certain stars, and most nebulæ, have spectra consisting chiefly of a line brightest on the redward side, and identified by Lockyer as the remnant of a fluting in the spectrum of magnesium. A similar spectrum was observed by Huggins in two faint comets that appeared in 1866 and 1867.

(2) Certain stars (Group II. of the Meteoritic Classification) have spectra made up of the radiation of carbon, and the absorption of flutings due to manganese and lead. Precisely similar spectra have been observed in many comets.

(3) Comets that have approached very near to the sun, *e.g.*, the great comet of 1882, and comet *b* 1881, exhibit spectra of bright and dark lines similar to those shown by stars of Group III. of the Meteoritic Classification.

Differences.

(1) The spectra of stars usually consist of dark lines, whereas comets generally show bright lines and bands.

(2) Leaving new stars out of consideration, the spectrum of a star is constant over a considerable period of time, whereas a cometary spectrum changes as the comet travels round the sun.

The sequence of changes undergone by the spectrum of a comet while the comet is passing from aphelion to perihelion is matched by stars from Groups I. to III. of Lockyer's Classification. And since it is agreed that a comet is a swarm of meteorites drawn into the solar system, there is every probability that stars of Groups I. to III. are condensing swarms of meteorites outside our system.

23. Give an account of the changes observed in the number and position of sun spots during an eleven-year period.

The proportion of spotted surface of the sun is at times much greater than others, and fluctuates periodically. During some years, scarcely a day passes without a spot or groups of spots being seen, while several weeks may pass in other years without a spot being visible. When the spots are most numerous a *maximum* of solar activity is said to have been reached, and a *minimum* of activity denotes the time when spots are fewest. The last minimum was passed in June 1889, and we are now in a maximum. Rather more than eleven years separate two consecutive maxima or minima, but the rise to a maximum is always more rapid than the fall to a minimum. The interval from minimum to maximum is usually about 4½ years, and that from maximum to minimum is about 6½ years. With regard to the cyclic change of position, it is found that, immediately after a minimum, spots break out in high solar latitudes. The mean latitude in which spots occur then slowly approaches the equator until the time of the following minimum, after which spots again break out in high latitudes. Thus, in 1879, when spots were few but increasing in number and extent, the mean solar latitude of occurrence was about 24°, but in 1889, that is, at the following minimum, the mean latitude was only 6°, the spots approaching the equator both when they were increasing and when they were decreasing in frequency.

24. How has the map of England from the Shetlands to the Isle of Wight been constructed, with special reference to the latitudes and the distances apart of the several places shewn?

In order to construct a map such as that described, it is necessary (1) to measure with extreme accuracy the length of a base-line, (2) to determine by triangulation the size of the tract between the limiting stations, (3) to find the difference of latitude between these stations. For the measurement of the base-line, Colby's compensating-bars were employed in the English Ordnance Survey. These are constructed in such a manner that their length is not affected by fluctuations of temperature. After the base-line had been measured, theodolites were taken to each extremity of it, and directed to some conspicuous object, such as a church-spire. Each of the two directions in which the spire was observed made a certain angle with the direction of the base-line. From the two angles and the measured length the distance of the object was then calculated. Using the calculated length as a second base-line, the distance of a third object was similarly found by taking sights from its two extremities, and so on until the tract of country from the Shetlands to the Isle of Wight was covered with a network of triangles of known extent. The distance apart of any places within the triangulation was therefore found by reference to the geodetic measures. The latitudes, however, involved a new set of observations. It can be proved that the latitude of any place on the earth is equal to the declination of a star plus its zenith distance. And since the declinations of stars have been determined with great accuracy and catalogued, it was only necessary to observe the zenith distance of a star in order to have the requisite data for a calculation of latitude. This observation was made by means of a zenith sector, which consists essentially of a plumb-line to locate the zenith, or a spirit-level to establish the horizon, which is 90° from the zenith. The angle which the axis of a small telescope makes with the plumb-line when it is pointed to a star, is the zenith distance of that star. And the latitude of the place is equal to this angle, added to the star's catalogued declination. Stars were selected near the zenith because the measures were less likely to be vitiated by the effects of refraction. Having determined the distance separating the limiting station, and the difference of latitude between them, parallels of latitude were drawn upon the triangulation, so that both the difference of latitude and the distance between any intermediate places could easily be estimated.

25. State what you know concerning:—

(*a*) The physical characters of lava.
(*b*) The chemical composition of lava.
(*c*) Name three different kinds of lavas.
(*d*) Why is lava sometimes 'scoriaceous.'

(*a*) Some lavas are entirely crystalline, while others have a vitreous or glassy structure and exhibit very little, if any, crystalline arrangement. In fact, there is every gradation between glassy lavas and those of a wholly crystalline structure. Rhyolites are lavas consisting of similar materials to those of granite (which they much resemble), but in all of them the rock base contains some vitreous or glassy substance. Obsidian is a glassy lava possessing a perfectly vitreous lustre. Basalt has a black granular appearance and a high specific gravity, and there are some lavas which have the same general appearance as the slags formed in furnaces. Vesicularity is a common characteristic, being formed by the escape of gases contained in lava.

(*b*) Mainly silicates of aluminium, magnesium, calcium, iron, sodium, and potassium. *Acid* lavas, such as liparite or rhyolite and obsidian, contain, on the average, from 70 to 75 per

cent. of silica in combination with the bases alumina, potash, soda, &c. In *intermediate* lavas, such as trachyte, from 55 to 66 per cent. of silica is present. *Basic* lavas, *e.g.* basalt, only contain about 50 per cent. of silica.

(*c*) Obsidian, trachyte, basalt.

(*d*) Because of the escape of steam and gases from the interior of the mass. Pumice is formed by this means from very fluid acid lava. Water vapour is generally present in a great quantity in escaping lava, hence, directly the stream reaches the surface, and the pressure is therefore lessened, the vapour is disengaged and the lava is thereby distended and given a cellular or scoriaceous appearance.

26. Describe the following :—

(*a*) Globigerina ooze,
(*b*) Radiolarian ooze,
(*c*) Diatomaceous ooze,
(*d*) Red clay,

Stating in each case under what conditions the materials are found.

(*a*) A fine soft mud; white, yellow, brown or red, according to the occurrence of oxides of iron and manganese. When dry it is like powdered chalk, and it has the same chemical constitution (carbonate of lime). It consists almost entirely of the dead shells of animals known as Globigerinæ, belonging to the group Foraminifera. The proportion of carbonate of lime varies from 40 to 95 per cent., according to the depth from which the ooze is obtained. It is an abysmal oceanic deposit, and occurs in tropical and sub-tropical regions between the depths of 500 and 2,800 fathoms.

(*b*) The minute shells and fragments of Radiolaria, that is, animals having the power of secreting silica from sea water. In some regions the deposit consists principally of the skeletons of Radiolaria, with scarcely a trace of carbonate of lime; but in others the remains of Foraminifera make up as much as 20 per cent. of the ooze. It occurs in the Central Pacific at a mean depth of nearly 2,894 fathoms. Calcareous shells do not occur at great depths in the ocean, owing to their being dissolved by the water. Remains of Radiolaria and other siliceous organisms, however, exist at all depths.

(*c*) A pale, straw-coloured material, composed chiefly of the remains of microscopic plants, called diatoms, that live in the ocean and secrete silica to build up their shells. About 25 per cent. of carbonate of lime usually occurs in Diatomaceous ooze in the form of Globigeria shells. It is found on the ocean-floor in latitudes higher than about 45° south.

(*d*) This deposit characterises all the deepest parts of the ocean, and is found, at depths greater than 2,200 fathoms, between the latitudes 45° N. and 45° S. Much of it probably represents the residue which results from the decomposition of the skeletons of calcareous organisms. In some of the clays, only a small proportion of silicate of aluminium is present, the remainder consisting of minute mineral fragments and remains of siliceous organisms. The mineral particles seem mostly to have a volcanic origin, and exist in a more or less altered condition. Sharks' teeth, the ear bones of whales, and portions of the bones of other marine animals also occur in red clays, embedded in thick coatings of oxides of iron and manganese—compounds which give the clays their characteristic brownish or red colour. A number of minute specks of iron and manganese have been identified as of meteoritic origin.

27. The atmosphere is at least 200 miles in height, but when we ascend to the height of 3½ miles the mercury in the barometer falls to half its height. Explain the reason of this.

Since the mercury in the barometer falls to half its height at sea-level on ascending 3½ miles, the atmospheric pressure must be one-half the pressure at sea-level. In other words, a column of air from sea-level to a height of 3½ miles exerts the same pressure as a column extending from that height to the limits of the atmosphere. Half the whole atmosphere, therefore, exists below a height of 3½ miles. This results from the fact that the volume occupied by a gas is inversely proportional to the pressure to which the gas is subjected. Owing to the pressure of the upper layers of the atmosphere the volume of the lower portions is decreased. On this account also the density of the atmosphere diminishes from sea-level upwards, for it is proportional to the pressure.

28. (*a*) Describe the Gulf Stream.
(*b*) How does it originate?
(*c*) State its effects on climate.
(*d*) What is the 'Sargasso Sea?'

(*a*) The Gulf Stream flows from the Gulf of Mexico along the coast of North America to Newfoundland. A portion of the stream then becomes part of the right-handed vortex that circulates in the North Atlantic, and it is held by many that only this portion which completes its circuit constitutes the Gulf Stream proper. From Newfoundland a north-eastern branch, sometimes called the Gulf Stream Drift, flows slowly on and reaches the shores of the British Isles, Norway, and Spitzbergen. The surface temperature of the stream as it passes the Florida Strait is about 75° Fahr. The breadth of the stream near this point is about 35 miles, its depth is about 3,000 feet, and velocity nearly five miles an hour. When the stream flows past Newfoundland, its breadth is more than 300 miles, depth nearly 1,200 feet, and velocity rather more than a mile an hour. Between Scotland and Ireland the width of the drift is quite 600 miles, and the velocity does not much exceed half-a-mile per hour.

(*b*) In consequence of the difference of temperature between equatorial and polar regions, there is a general movement of warmer and lighter surface-water from the equator to the poles, and colder and heavier bottom water from the poles to the equator. But owing to the earth's rotation, currents from the equator are deflected towards the east, while those flowing to the equator are given a westward bias. Hence, when the great equatorial current strikes against the eastern shore of America, the portion that turns northwards takes a north-east direction. A return current flows along the west shores of Spain and Africa, and finally mixes with the equatorial current. A whirl of water is thus formed in which the direction of motion is the same as that of the hands of a watch. Doubtless prevailing winds play an important part in determining the direction of ocean currents, indeed it is very probable that this cause is even more active than the difference in temperature of ocean water.

(*c*) The air lying on any surface tends to acquire the temperature of that surface. Since, then, the Gulf Stream has a higher temperature than the water through which it flows, the winds that come with it are given a higher temperature than they would have if the stream did not exist. Further, since the temperature of the stream is not subject to any great seasonal variation, the winds subscribe to the same uniformity, and the range of temperature of the regions over which they blow is therefore diminished. Again, winds blowing from warm water surfaces are necessarily moist as well as warm, so both the humidity and temperature of places to which such winds blow are affected. If there were no atmosphere, ocean currents alone would have little influence upon the climate of a place.

(*d*) The centre of the right-handed vortex of water in the North Atlantic is comparatively still, and over a considerable portion of this stagnant area grow dense masses of a rootless seaweed termed *sargassum bacciferum*. This area is known as the Sargasso Sea.

QUERY COLUMN.

GEOMETRY.

TYKE.—If O is a fixed point, and the ratio OP : OQ is constant, then if the locus of P is a straight line, so also is that of Q.

(Rider to VI. 2.)

Draw any straight line from O of unlimited length, and let it represent the locus of P.

Take a line OQ, so that as (OP drawn from O to a point P in the locus of P) is to OQ is the given ratio.

Join PQ.

Take any other point P_1 in the locus of P, and through P_1 draw $P_1 Q_1$ parallel to PQ, and meeting OQ produced in Q_1.

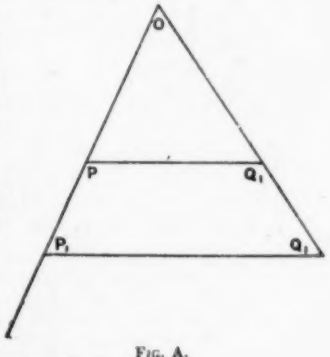


FIG. A.

Proof—

OP : OP_1 : : OQ : OQ_1 (VI. 2.)

∴ OP : OQ : : OP_1 : OQ_1 (V. 16.)

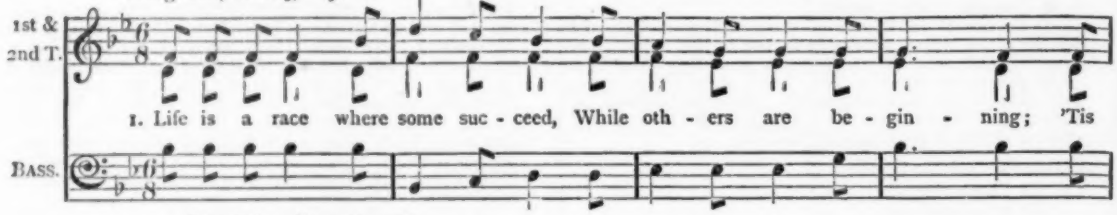
That is, OP_1 : OQ_1 as the given ratio.

Wherefore Q_1 is a point in the locus of Q.

∴ Locus of Q is a straight line.—Q.E.D.

'TIS BETTER LATE THAN NEVER.

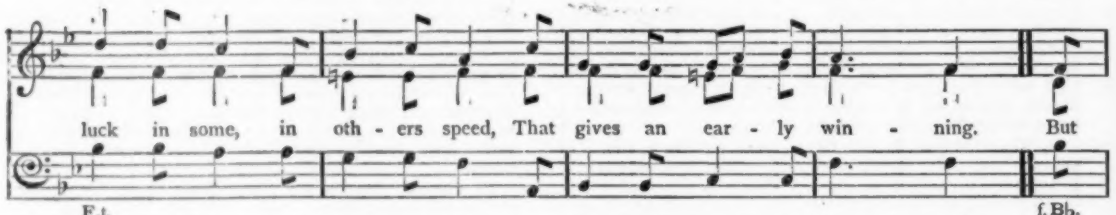
Allegretto, No. 25, *mf.*



Key B♭. *allegretto, mf.*

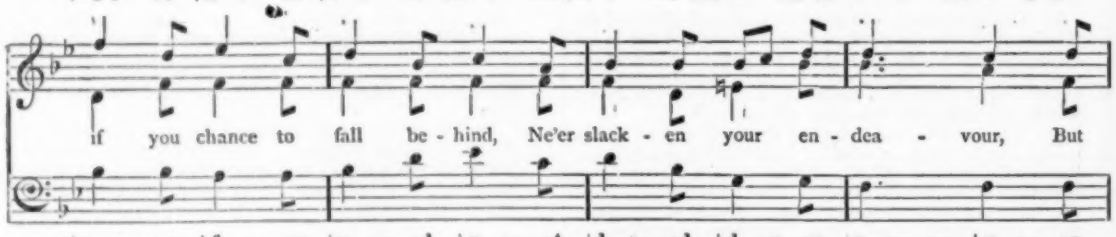
1st & 2nd T. / B.

1. Life is a race where | some suc - ceed, While | oth - ers are be- | gin - ning; 'Tis

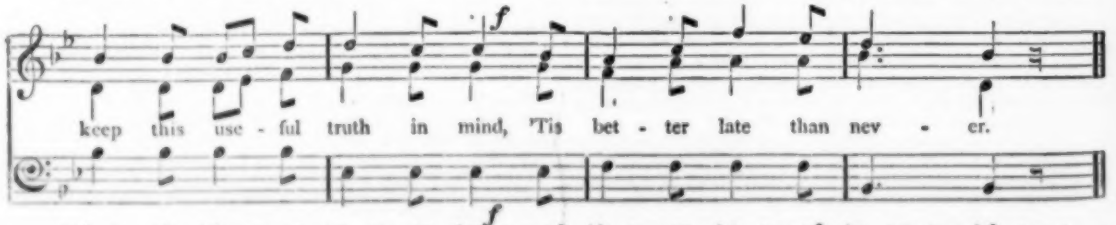


F.t. f. B♭.

luck in some, in | oth - ers speed, That | gives an ear - ly | win - ning. | But



if you chance to | fall be - hind, Ne'er | slack - en your en- | dea - vour, | But



keep this use - ful | truth in mind, 'Tis | bet - ter late than | nev - er.

2. If you can keep ahead 'tis well,
But never trip your neighbour;
'Tis noble when you can excel
By honest patient labour.
And if you are out-stripp'd at last,
Press on as bold as ever;
Remember, though you are surpass'd,
'Tis better late than never.

3. Strive not to gain an idle boast,
Or victory o'er another;
But, while you strive your uttermost,
Deal fairly with a brother.
Whate'er your station do your best,
And hold your purpose ever;
And though you fail to beat the rest,
'Tis better late than never.

L'AVARE.

(*Molière.*)

TRANSLATED BY PROFESSOR DARQUÉ.—(*Author of 'Pupil Teachers' French Course.'*)

L'AVARE.

SCÈNE II.

HARPAGON, MAÎTRE SIMON, CLÉANTE, LA FLÈCHE

(*dans le fond du théâtre*).

MAÎTRE SIMON. Oui, monsieur, c'est un jeune homme qui a besoin d'argent. Ses affaires le pressent d'en trouver, et il en passera par tout ce que vous en prescrirez.

HARPAGON. Mais croyez-vous, maître Simon, qu'il n'y ait rien à péricliter ? et savez-vous le nom, les biens, et la famille de celui pour qui vous parlez ?

MAÎTRE SIMON. Non. Je ne puis pas bien vous en instruire à fond, et ce n'est que par aventure que l'on m'a adressé à lui ; mais vous serez de toutes choses éclairci par lui-même, et son homme m'a assuré que vous serez content quand vous le connaîtrez.[121] Tout ce que je saurais vous dire, c'est que sa famille est fort riche, qu'il n'a plus de mère déjà, et qu'il s'obligera, si vous voulez, que son père mourra avant qu'il soit huit mois.[122]

HARPAGON. C'est quelque chose que cela. La charité, maître Simon, nous oblige à faire plaisir aux personnes, lorsque nous le pouvons.

MAÎTRE SIMON. Cela s'entend.

LA FLÈCHE (*bas à Cléante, reconnaissant maître Simon*). Que veut dire ceci ? Notre maître Simon qui[123] parle à votre père !

CLÉANTE (*bas à la Flèche*). Lui aurait-on appris qui je suis ? et serais-tu pour nous trahir ?

MAÎTRE SIMON (*à Cléante et à la Flèche*). Ah ! ah ! vous êtes bien pressés ! Qui vous a dit que c'était céans ?[124] (*A Harpagon.*) Ce n'est pas moi, monsieur, au moins, qui leur ai découvert votre nom et votre logis ; mais à mon avis, il n'y a pas grand mal à cela. Ce sont des personnes discrètes, et vous pouvez ici vous expliquer ensemble.

HARPAGON. Comment ?

MAÎTRE SIMON (*montrant Cléante*). Monsieur est la personne qui veut vous emprunter les quinze mille livres dont je vous ai parlé.

HARPAGON. Comment, pendard ![125] c'est toi qui t'abandonnes à ces coupables extrémités ?

CLÉANTE. Comment, mon père, c'est vous qui vous portez à ces honteuses actions ?

(*Maître Simon s'enfuit, et La Flèche va se cacher.*)

THE MISER.

SCENE II.

HARPAGON, MASTER SIMON, CLÉANTE, LA FLÈCHE.

(*at the back of the stage*).

MASTER SIMON. Yes, sir, he is a young man who is in want of money. His affairs compel him to find some, and he will accept whatever conditions you may dictate.

HARPAGON. But do you think, Master Simon, that there is no risk to run ? and do you know the name, fortune, and family of him for whom you speak ?

MASTER SIMON. No ; I cannot tell you exactly, and it is only by accident that I was made to speak to him ; but you will be informed of everything by himself, and his servant assured me that you will be satisfied when you know him. All I can tell you is that his family is very rich, that his mother is already dead, and that he will bind himself, should you wish it, that his father shall die before eight months.

HARPAGON. That is something. Charity, Master Simon, compels us to please (oblige) people when we can do so.

MASTER SIMON. Of course.

LA FLÈCHE (*in a low tone to Cléante, on recognising Master Simon*). What does this mean ? Our Master Simon speaking to your father !

CLÉANTE (*in a low tone to La Flèche*). Has he perchance been told who I am ? and are you betraying us ?

MASTER SIMON (*to Cléante and La Flèche*). Oh ! ah ! you are in a great hurry ! Who told you it was here ? (*To Harpagon.*) It is not I, at least (I assure you), who told them your name and residence ; but in my opinion there is no great harm in that. They are discreet people, and you can here settle matters together.

HARPAGON. What ?

MASTER SIMON (*showing Cléante*). This gentleman is the person who wants to borrow from you the six hundred pounds, of which I spoke to you.

HARPAGON. What, rascal ! it is you who give way to those guilty extremities ?

CLÉANTE. What, father, it is you who practise those shameful deeds ?

(*Master Simon runs away, and La Flèche goes and hides himself.*)

NOTES.

(121) *Connaîtrez.* Notice again the use of the future in French instead of the present, as in English.

(122) *Avant huit mois* has the same meaning as *avant qu'il soit huit mois*, but is not so emphatic.

(123) *Qui parle.* The relative pronoun can only be justified on the supposition that *Voilà* or some equivalent words are understood at the beginning of the sentence.

(124) *Céans* is now obsolete ; *ici* has usurped its place.

(125) *Pendard* may be more literally translated by 'hang-dog.'

15.

Suddenly the command is given to retire, and, as victors shouting triumph, they march from the field. Then appears upon the scene a horde of wild-looking creatures, running and leaping from place to place, screaming, and frantically beating the earth with thick, heavy clubs. These are the women, and they are engaged in the horrible atrocity of killing the wounded. After a sham fight, the night is spent in feasting and revelry.—(H.M.I's Test.)

STANDARDS V.–VII.

1.

It has been frequently said that after all there is no city in the world like London, and we usually give a nod of assent without so much as a moment's thought of the matter. From time to time, however, the fact is borne in upon us in a way too striking to be so callously passed over. The London General Omnibus Company are the latest to give a hitch to our lagging consciousness. It seems that in the last six months of 1889 eight hundred and thirty vehicles belonging to the Company carried fifty-three and a half million passengers, or close upon three hundred thousand a day!

2.

Universal education cannot fail to prove a most potent lever in the hands of temperance workers. It will develop the stunted intelligence of the lower labouring classes—the classes that are now the most regular and wretched patrons of the public-house, and enable them to recognize their own degradation. Education will beget new tastes and destroy old ones. It will show a man that the feverish tumult of the bar-room is not so good a thing as the decent quiet of the reading-room or library. And as men become masters of themselves, as they see their own divinity, and awaken to new possibilities, crime will diminish.

3.

The King of Siam is said to have in one of his country places a wonderful pavilion. It was built by a Chinese engineer as a refuge for the king during the extreme heat of the summer. The walls, ceilings, and floors are formed of pieces of plate glass an inch thick. They are so perfectly fitted together with a transparent cement that the joints are invisible, and no fluid can penetrate. The pavilion is twenty-eight feet long, seventeen wide, and stands in the middle of a huge basin made of beautifully coloured marbles. When the king enters the pavilion the single door is closed and cemented.

4.

During long and tedious railway journeys taken in the day-time, one is scarcely to be blamed for killing time with a book or paper; but for the attempt to read at night in dimly-lighted carriages, as many do, there is no excuse, and if the habit is persisted in, the result is impairment of the sight, if not some serious disease of the eyes. During the day, in rapidly moving trains, the light is constantly changing, and they roll so unevenly that it is difficult for a person reading to hold the book or paper steadily. The result is that the muscles of the eyes are constantly strained and become weakened.

5.

The great affliction which has befallen the Royal Family has sent a thrill of sorrow through the length and breadth of the Empire. The young life which has been so suddenly snatched away stood to us all in such a peculiar position, that without any exaggeration it may be said that the death of the Duke of Clarence and Avondale will affect the whole future history of our country. As standing in the line of direct succession to the Throne, and as the future Sovereign of these realms, if nature had run its ordinary course, the young prince was marked out, in the national eye, from all others, and was, in a very special way, an object of universal love and solicitude.—(H.M.I.'s Test.)

6.

Work, either of the muscles or the brain, is one of the conditions of human happiness. Without it there can be no wholesome enjoyment. The idle man either seeks a substitute for the healthy excitement of labour in vicious indulgence, or degenerates into a being only a few degrees above the lower animals. His soul and mind, in the one case, become degraded and debased by false uses; in the other, they rust within him, and he is left to the government of the mere instincts which he possesses in common with the brute.

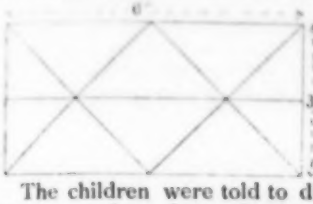
7.

There are various sounds in nature all plaintive and sad; the voice of the winds, the chime of waves, and the song of birds, are all in the minor key, as if all creation groaned and travailed in pain, waiting for that grand deliverance, which is the burden of prophecies, when the great Composer shall transpose all her strains from the minor into the major, and the wild wail of nature shall give way to the glad harmony of the everlasting jubilee, the joyous strains of which shall reverberate from heaven to earth, and the wide universe be as a whispering gallery, ever repeating sweet music.

A RECENT DRAWING EXAMINATION IN A COUNTRY SCHOOL IN YORKSHIRE.

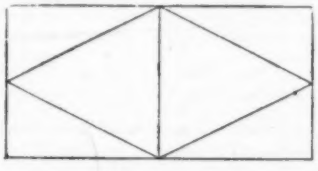
STANDARDS 1 and 2.

THE Inspector asked the teacher to draw the following figure on the blackboard, viz., an oblong, 6 inches by 3, showing its construction line by line. The sides to be all bi-sected, and lines drawn to the points of bi-section as below.



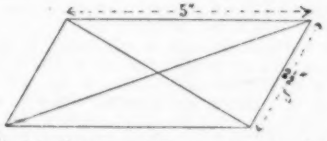
The children were told to divide their slates and papers, and to draw (freehand) the figure in the upper half. The rulers were then given out, and the same figure had to be drawn in the lower half of papers, to measure. Questions were asked on the angles.

Some in Standard 2 did this, freehand, as large as the paper would take in.

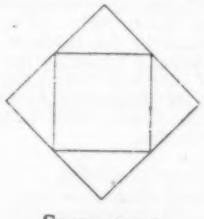


STANDARD 3.

The following figure was on a large paper, and had to be copied, first, freehand, in the upper half of paper, and then with rulers in the lower half.

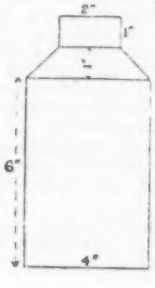


Some did this freehand from copy on board.

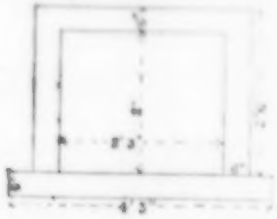


STANDARD 4.

Some had this on squared paper, four squares to one inch.



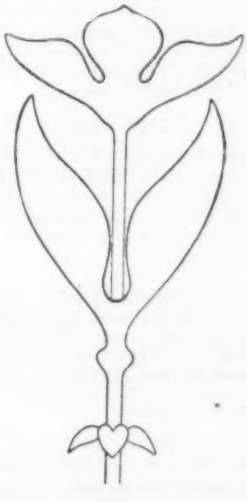
One had this on card, to draw on plain paper. Scale 1 inch to 1 foot.



One had this to do as large as paper would hold.

One had to draw a pump from card, and to make it twice the size of copy.

Another card was this.



ANSWERS TO QUESTIONS IN ADVANCED PHYSIOGRAPHY.

MAY EXAMINATION, 1893.

BY R. A. GREGORY, F.R.A.S.,

Oxford University Extension Lecturer, Author of 'Elementary Physiography,' 'Physical and Astronomical Geography,' &c.

THE following questions are from the Physiography Examination Paper set in May, and refer to the Advanced Stage. Students should always remember, however, that it is a waste of time to write out each question before answering it. It is quite sufficient to put the number of the question before the answer.

21. According to the almanacs the time of sunset from December 7 to December 13 is constant, while the time of sunrise during the same period varies by ten minutes. Why is this?

The variation is due to the difference between mean time, that is, the time given in almanacs, and true or apparent solar time. Between the dates mentioned, the equation of time is *negative* and diminishing; in other words, a less amount has to be subtracted from apparent time every day in order to convert it into mean time. But at the same time, the sun sets earlier every day owing to its increasing southern declination. And since the loss due to the former cause is approximately equal to the gain due to the latter, the mean time of sunset remains constant. Taking the case of sunrise, and counting from noon in mean time, we still have the equation of time negative and diminishing, while the sun rises later every day owing to its increasing southern declination. Both the corrections to be applied to the mean-time interval from noon to sunrise are therefore negative, whereas, in the case of sunset, one is positive and the other negative. On this account, the mean time of sunset is practically constant, while that of sunrise varies by ten minutes.

22. Contrast the spectra of stars with those of comets.

Similarities.

(1) Certain stars, and most nebulæ, have spectra consisting chiefly of a line brightest on the redward side, and identified by Lockyer as the remnant of a fluting in the spectrum of magnesium. A similar spectrum was observed by Huggins in two faint comets that appeared in 1866 and 1867.

(2) Certain stars (Group II. of the Meteoritic Classification) have spectra made up of the radiation of carbon, and the absorption of flutings due to manganese and lead. Precisely similar spectra have been observed in many comets.

(3) Comets that have approached very near to the sun, *e.g.*, the great comet of 1882, and comet *b* 1881, exhibit spectra of bright and dark lines similar to those shown by stars of Group III. of the Meteoritic Classification.

Differences.

(1) The spectra of stars usually consist of dark lines, whereas comets generally show bright lines and bands.

(2) Leaving new stars out of consideration, the spectrum of a star is constant over a considerable period of time, whereas a cometary spectrum changes as the comet travels round the sun.

The sequence of changes undergone by the spectrum of a comet while the comet is passing from aphelion to perihelion is matched by stars from Groups I. to III. of Lockyer's Classification. And since it is agreed that a comet is a swarm of meteorites drawn into the solar system, there is every probability that stars of Groups I. to III. are condensing swarms of meteorites outside our system.

23. Give an account of the changes observed in the number and position of sun spots during an eleven-year period.

The proportion of spotted surface of the sun is at times much greater than others, and fluctuates periodically. During some years, scarcely a day passes without a spot or groups of spots being seen, while several weeks may pass in other years without a spot being visible. When the spots are most numerous a *maximum* of solar activity is said to have been reached, and a *minimum* of activity denotes the time when spots are fewest. The last minimum was passed in June 1889, and we are now in a maximum. Rather more than eleven years separate two consecutive maxima or minima, but the rise to a maximum is always more rapid than the fall to a minimum. The interval from minimum to maximum is usually about 4½ years, and that from maximum to minimum is about 6½ years. With regard to the cyclic change of position, it is found that, immediately after a minimum, spots break out in high solar latitudes. The mean latitude in which spots occur then slowly approaches the equator until the time of the following minimum, after which spots again break out in high latitudes. Thus, in 1879, when spots were few but increasing in number and extent, the mean solar latitude of occurrence was about 24°, but in 1889, that is, at the following minimum, the mean latitude was only 6°, the spots approaching the equator both when they were increasing and when they were decreasing in frequency.

24. How has the map of England from the Shetlands to the Isle of Wight been constructed, with special reference to the latitudes and the distances apart of the several places shewn?

In order to construct a map such as that described, it is necessary (1) to measure with extreme accuracy the length of a base-line, (2) to determine by triangulation the size of the tract between the limiting stations, (3) to find the difference of latitude between these stations. For the measurement of the base-line, Colby's compensating-bars were employed in the English Ordnance Survey. These are constructed in such a manner that their length is not affected by fluctuations of temperature. After the base-line had been measured, theodolites were taken to each extremity of it, and directed to some conspicuous object, such as a church-spire. Each of the two directions in which the spire was observed made a certain angle with the direction of the base-line. From the two angles and the measured length the distance of the object was then calculated. Using the calculated length as a second base-line, the distance of a third object was similarly found by taking sights from its two extremities, and so on until the tract of country from the Shetlands to the Isle of Wight was covered with a network of triangles of known extent. The distance apart of any places within the triangulation was therefore found by reference to the geodetic measures. The latitudes, however, involved a new set of observations. It can be proved that the latitude of any place on the earth is equal to the declination of a star plus its zenith distance. And since the declinations of stars have been determined with great accuracy and catalogued, it was only necessary to observe the zenith distance of a star in order to have the requisite data for a calculation of latitude. This observation was made by means of a zenith sector, which consists essentially of a plumb-line to locate the zenith, or a spirit-level to establish the horizon, which is 90° from the zenith. The angle which the axis of a small telescope makes with the plumb-line when it is pointed to a star, is the zenith distance of that star. And the latitude of the place is equal to this angle, added to the star's catalogued declination. Stars were selected near the zenith because the measures were less likely to be vitiated by the effects of refraction. Having determined the distance separating the limiting station, and the difference of latitude between them, parallels of latitude were drawn upon the triangulation, so that both the difference of latitude and the distance between any intermediate places could easily be estimated.

25. State what you know concerning:—

(*a*) The physical characters of lava.
(*b*) The chemical composition of lava.
(*c*) Name three different kinds of lavas.
(*d*) Why is lava sometimes 'scoriaceous.'

(*a*) Some lavas are entirely crystalline, while others have a vitreous or glassy structure and exhibit very little, if any, crystalline arrangement. In fact, there is every gradation between glassy lavas and those of a wholly crystalline structure. Rhyolites are lavas consisting of similar materials to those of granite (which they much resemble), but in all of them the rock base contains some vitreous or glassy substance. Obsidian is a glassy lava possessing a perfectly vitreous lustre. Basalt has a black granular appearance and a high specific gravity, and there are some lavas which have the same general appearance as the slags formed in furnaces. Vesicularity is a common characteristic, being formed by the escape of gases contained in lava.

(*b*) Mainly silicates of aluminium, magnesium, calcium, iron, sodium, and potassium. *Acid* lavas, such as liparite or rhyolite and obsidian, contain, on the average, from 70 to 75 per

cent. of silica in combination with the bases alumina, potash, soda, &c. In *intermediate* lavas, such as trachyte, from 55 to 66 per cent. of silica is present. *Basic* lavas, *e.g.* basalt, only contain about 50 per cent. of silica.

(*c*) Obsidian, trachyte, basalt.

(*d*) Because of the escape of steam and gases from the interior of the mass. Pumice is formed by this means from very fluid acid lava. Water vapour is generally present in a great quantity in escaping lava, hence, directly the stream reaches the surface, and the pressure is therefore lessened, the vapour is disengaged and the lava is thereby distended and given a cellular or scoriaceous appearance.

26. Describe the following :—

(*a*) Globigerina ooze,
(*b*) Radiolarian ooze,
(*c*) Diatomaceous ooze,
(*d*) Red clay,

Stating in each case under what conditions the materials are found.

(*a*) A fine soft mud; white, yellow, brown or red, according to the occurrence of oxides of iron and manganese. When dry it is like powdered chalk, and it has the same chemical constitution (carbonate of lime). It consists almost entirely of the dead shells of animals known as Globigerinæ, belonging to the group Foraminifera. The proportion of carbonate of lime varies from 40 to 95 per cent., according to the depth from which the ooze is obtained. It is an abysmal oceanic deposit, and occurs in tropical and sub-tropical regions between the depths of 500 and 2,800 fathoms.

(*b*) The minute shells and fragments of Radiolaria, that is, animals having the power of secreting silica from sea water. In some regions the deposit consists principally of the skeletons of Radiolaria, with scarcely a trace of carbonate of lime; but in others the remains of Foraminifera make up as much as 20 per cent. of the ooze. It occurs in the Central Pacific at a mean depth of nearly 2,894 fathoms. Calcareous shells do not occur at great depths in the ocean, owing to their being dissolved by the water. Remains of Radiolaria and other siliceous organisms, however, exist at all depths.

(*c*) A pale, straw-coloured material, composed chiefly of the remains of microscopic plants, called diatoms, that live in the ocean and secrete silica to build up their shells. About 25 per cent. of carbonate of lime usually occurs in Diatomaceous ooze in the form of Globigeria shells. It is found on the ocean-floor in latitudes higher than about 45° south.

(*d*) This deposit characterises all the deepest parts of the ocean, and is found, at depths greater than 2,200 fathoms, between the latitudes 45° N. and 45° S. Much of it probably represents the residue which results from the decomposition of the skeletons of calcareous organisms. In some of the clays, only a small proportion of silicate of aluminium is present, the remainder consisting of minute mineral fragments and remains of siliceous organisms. The mineral particles seem mostly to have a volcanic origin, and exist in a more or less altered condition. Sharks' teeth, the ear bones of whales, and portions of the bones of other marine animals also occur in red clays, embedded in thick coatings of oxides of iron and manganese—compounds which give the clays their characteristic brownish or red colour. A number of minute specks of iron and manganese have been identified as of meteoritic origin.

27. The atmosphere is at least 200 miles in height, but when we ascend to the height of 3½ miles the mercury in the barometer falls to half its height. Explain the reason of this.

Since the mercury in the barometer falls to half its height at sea-level on ascending 3½ miles, the atmospheric pressure must be one-half the pressure at sea-level. In other words, a column of air from sea-level to a height of 3½ miles exerts the same pressure as a column extending from that height to the limits of the atmosphere. Half the whole atmosphere, therefore, exists below a height of 3½ miles. This results from the fact that the volume occupied by a gas is inversely proportional to the pressure to which the gas is subjected. Owing to the pressure of the upper layers of the atmosphere the volume of the lower portions is decreased. On this account also the density of the atmosphere diminishes from sea-level upwards, for it is proportional to the pressure.

28. (*a*) Describe the Gulf Stream.
(*b*) How does it originate?
(*c*) State its effects on climate.
(*d*) What is the 'Sargasso Sea?'

(*a*) The Gulf Stream flows from the Gulf of Mexico along the coast of North America to Newfoundland. A portion of the stream then becomes part of the right-handed vortex that circulates in the North Atlantic, and it is held by many that only this portion which completes its circuit constitutes the Gulf Stream proper. From Newfoundland a north-eastern branch, sometimes called the Gulf Stream Drift, flows slowly on and reaches the shores of the British Isles, Norway, and Spitzbergen. The surface temperature of the stream as it passes the Florida Strait is about 75° Fahr. The breadth of the stream near this point is about 35 miles, its depth is about 3,000 feet, and velocity nearly five miles an hour. When the stream flows past Newfoundland, its breadth is more than 300 miles, depth nearly 1,200 feet, and velocity rather more than a mile an hour. Between Scotland and Ireland the width of the drift is quite 600 miles, and the velocity does not much exceed half-a-mile per hour.

(*b*) In consequence of the difference of temperature between equatorial and polar regions, there is a general movement of warmer and lighter surface-water from the equator to the poles, and colder and heavier bottom water from the poles to the equator. But owing to the earth's rotation, currents from the equator are deflected towards the east, while those flowing to the equator are given a westward bias. Hence, when the great equatorial current strikes against the eastern shore of America, the portion that turns northwards takes a north-east direction. A return current flows along the west shores of Spain and Africa, and finally mixes with the equatorial current. A whirl of water is thus formed in which the direction of motion is the same as that of the hands of a watch. Doubtless prevailing winds play an important part in determining the direction of ocean currents, indeed it is very probable that this cause is even more active than the difference in temperature of ocean water.

(*c*) The air lying on any surface tends to acquire the temperature of that surface. Since, then, the Gulf Stream has a higher temperature than the water through which it flows, the winds that come with it are given a higher temperature than they would have if the stream did not exist. Further, since the temperature of the stream is not subject to any great seasonal variation, the winds subscribe to the same uniformity, and the range of temperature of the regions over which they blow is therefore diminished. Again, winds blowing from warm water surfaces are necessarily moist as well as warm, so both the humidity and temperature of places to which such winds blow are affected. If there were no atmosphere, ocean currents alone would have little influence upon the climate of a place.

(*d*) The centre of the right-handed vortex of water in the North Atlantic is comparatively still, and over a considerable portion of this stagnant area grow dense masses of a rootless seaweed termed *sargassum bacciferum*. This area is known as the Sargasso Sea.

QUERY COLUMN.

GEOMETRY.

TYKE.—If O is a fixed point, and the ratio OP : OQ is constant, then if the locus of P is a straight line, so also is that of Q.

(Rider to VI. 2.)

Draw any straight line from O of unlimited length, and let it represent the locus of P.

Take a line OQ, so that as (OP drawn from O to a point P in the locus of P) is to OQ is the given ratio.

Join PQ.

Take any other point P_1 in the locus of P, and through P_1 draw $P_1 Q_1$ parallel to PQ, and meeting OQ produced in Q_1.

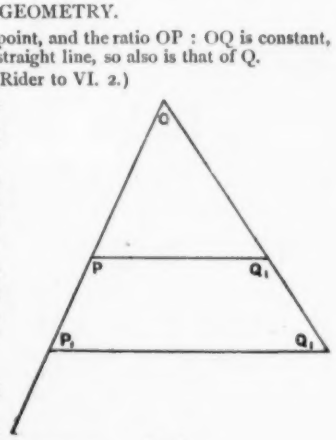


FIG. A.

Proof—

$OP : OP_1 :: OQ : OQ_1$ (VI. 2.)

$\therefore OP : OQ :: OP_1 : OQ_1$ (V. 16.)

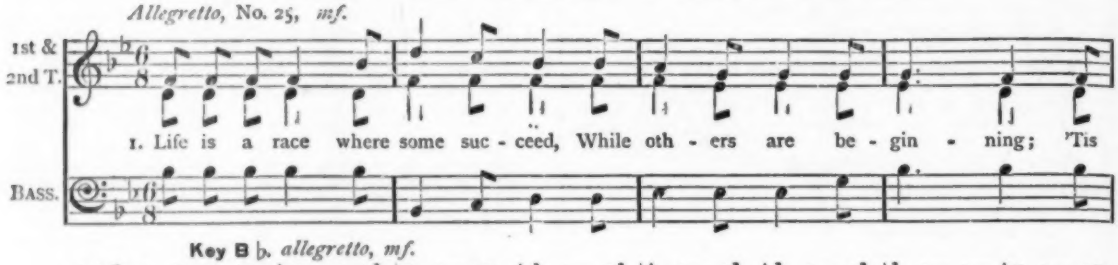
That is, $OP_1 : OQ_1$ as the given ratio.

Wherefore Q_1 is a point in the locus of Q.

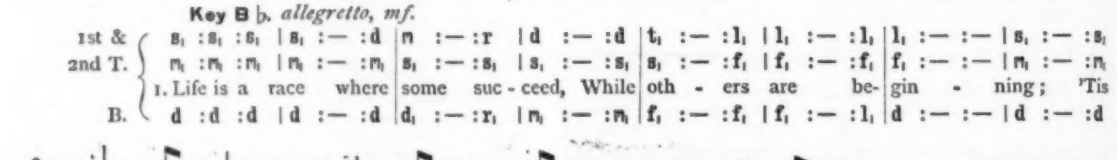
$\therefore$ Locus of Q is a straight line.—Q.E.D.

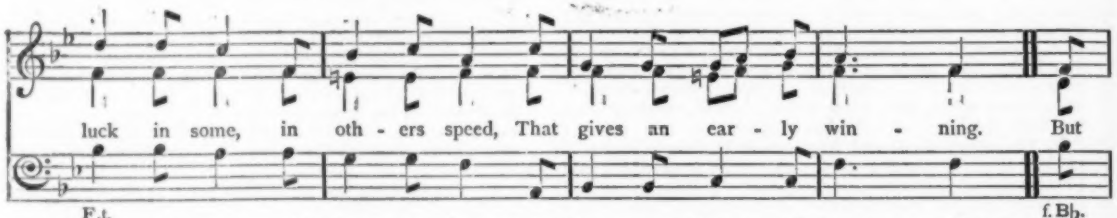
'TIS BETTER LATE THAN NEVER.

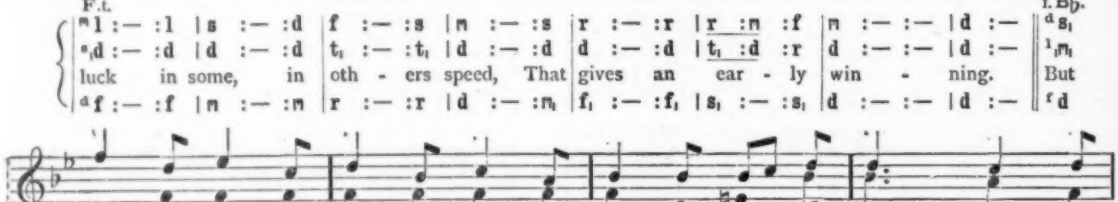
Allegretto, No. 25, *mf.*

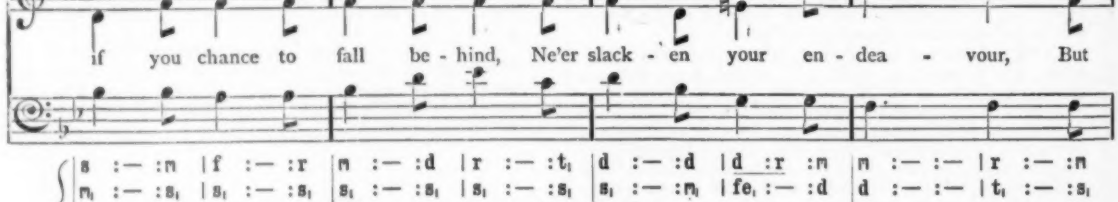


Key B♭. *allegretto, mf.*




luck in some, in oth - ers speed, That gives an ear - ly win - ning. But
F.t.
f. B♭.
luck in some, in oth - ers speed, That gives an ear - ly win - ning. But


if you chance to fall be - hind, Ne'er slack - en your en - dea - vour, But
if you chance to fall be - hind, Ne'er slack - en your en- dea - vour, But



2. If you can keep ahead 'tis well,
But never trip your neighbour;
'Tis noble when you can excel
By honest patient labour.
And if you are out-stripp'd at last,
Press on as bold as ever;
Remember, though you are surpass'd,
'Tis better late than never.

3. Strive not to gain an idle boast,
Or victory o'er another;
But, while you strive your uttermost,
Deal fairly with a brother.
Whate'er your station do your best,
And hold your purpose ever;
And though you fail to beat the rest,
'Tis better late than never.

L'AVARE.

(*Molière.*)

TRANSLATED BY PROFESSOR DARQUÉ.—(*Author of 'Pupil Teachers' French Course.'*)

L'AVARE.

SCÈNE II.

HARPAGON, MAÎTRE SIMON, CLÉANTE, LA FLÈCHE

(*dans le fond du théâtre*).

MAÎTRE SIMON. Oui, monsieur, c'est un jeune homme qui a besoin d'argent. Ses affaires le pressent d'en trouver, et il en passera par tout ce que vous en prescrirez.

HARPAGON. Mais croyez-vous, maître Simon, qu'il n'y ait rien à péricliter ? et savez-vous le nom, les biens, et la famille de celui pour qui vous parlez ?

MAÎTRE SIMON. Non. Je ne puis pas bien vous en instruire à fond, et ce n'est que par aventure que l'on m'a adressé à lui ; mais vous serez de toutes choses éclairci par lui-même, et son homme m'a assuré que vous serez content quand vous le connaîtrez.[121] Tout ce que je saurais vous dire, c'est que sa famille est fort riche, qu'il n'a plus de mère déjà, et qu'il s'obligera, si vous voulez, que son père mourra avant qu'il soit huit mois.[122]

HARPAGON. C'est quelque chose que cela. La charité, maître Simon, nous oblige à faire plaisir aux personnes, lorsque nous le pouvons.

MAÎTRE SIMON. Cela s'entend.

LA FLÈCHE (*bas à Cléante, reconnaissant maître Simon*). Que veut dire ceci ? Notre maître Simon qui[123] parle à votre père !

CLÉANTE (*bas à la Flèche*). Lui aurait-on appris qui je suis ? et serais-tu pour nous trahir ?

MAÎTRE SIMON (*à Cléante et à la Flèche*). Ah ! ah ! vous êtes bien pressés ! Qui vous a dit que c'était céans ?[124] (*A Harpagon.*) Ce n'est pas moi, monsieur, au moins, qui leur ai découvert votre nom et votre logis ; mais à mon avis, il n'y a pas grand mal à cela. Ce sont des personnes discrètes, et vous pouvez ici vous expliquer ensemble.

HARPAGON. Comment ?

MAÎTRE SIMON (*montrant Cléante*). Monsieur est la personne qui veut vous emprunter les quinze mille livres dont je vous ai parlé.

HARPAGON. Comment, pendard ![125] c'est toi qui t'abandonnes à ces coupables extrémités ?

CLÉANTE. Comment, mon père, c'est vous qui vous portez à ces honteuses actions ?

(*Maître Simon s'enfuit, et La Flèche va se cacher.*)

THE MISER.

SCENE II.

HARPAGON, MASTER SIMON, CLÉANTE, LA FLÈCHE.

(*at the back of the stage*).

MASTER SIMON. Yes, sir, he is a young man who is in want of money. His affairs compel him to find some, and he will accept whatever conditions you may dictate.

HARPAGON. But do you think, Master Simon, that there is no risk to run ? and do you know the name, fortune, and family of him for whom you speak ?

MASTER SIMON. No ; I cannot tell you exactly, and it is only by accident that I was made to speak to him ; but you will be informed of everything by himself, and his servant assured me that you will be satisfied when you know him. All I can tell you is that his family is very rich, that his mother is already dead, and that he will bind himself, should you wish it, that his father shall die before eight months.

HARPAGON. That is something. Charity, Master Simon, compels us to please (oblige) people when we can do so.

MASTER SIMON. Of course.

LA FLÈCHE (*in a low tone to Cléante, on recognising Master Simon*). What does this mean ? Our Master Simon speaking to your father !

CLÉANTE (*in a low tone to La Flèche*). Has he perchance been told who I am ? and are you betraying us ?

MASTER SIMON (*to Cléante and La Flèche*). Oh ! ah ! you are in a great hurry ! Who told you it was here ? (*To Harpagon.*) It is not I, at least (I assure you), who told them your name and residence ; but in my opinion there is no great harm in that. They are discreet people, and you can here settle matters together.

HARPAGON. What ?

MASTER SIMON (*showing Cléante*). This gentleman is the person who wants to borrow from you the six hundred pounds, of which I spoke to you.

HARPAGON. What, rascal ! it is you who give way to those guilty extremities ?

CLÉANTE. What, father, it is you who practise those shameful deeds ?

(*Master Simon runs away, and La Flèche goes and hides himself.*)

NOTES.

(121) *Connaîtrez.* Notice again the use of the future in French instead of the present, as in English.

(122) *Avant huit mois* has the same meaning as *avant qu'il soit huit mois*, but is not so emphatic.

(123) *Qui parle.* The relative pronoun can only be justified on the supposition that *Voilà* or some equivalent words are understood at the beginning of the sentence.

(124) *Céans* is now obsolete ; *ici* has usurped its place.

(125) *Pendard* may be more literally translated by 'hang-dog.'

SCÈNE III.

HARPAGON, CLÉANTE.

HARPAGON. C'est toi qui te veux ruiner par des emprunts si condamnables ?

CLÉANTE. C'est vous qui cherchez à vous enrichir par des usures si criminelles ?

HARPAGON. Oses-tu bien, après cela, paraître devant moi ?

CLÉANTE. Osez-vous bien, après cela, vous présenter aux yeux du monde?

HARPAGON. N'as-tu point de honte, dis-moi, d'en venir à ces débauches-là ? de te précipiter dans des dépenses effroyables ? et de faire une honteuse dissipation du bien que tes parents t'ont amassé avec tant de sueurs ?

CLÉANTE. Ne rougissez-vous point de déshonorer votre condition par les commerces que vous faites ? de sacrifier gloire et réputation au désir insatiable d'entasser écu sur écu ? et de renchérir, en fait d'intérêts, sur les plus infâmes subtilités qu'aient jamais inventées les plus célèbres usuriers ?

HARPAGON. Ote-toi de mes yeux, coquin ; ôte-toi de mes yeux !

CLÉANTE. Qui est plus criminel, à votre avis, ou[126] celui qui achète un argent dont il a besoin, ou bien celui qui vole un argent dont il n'a que faire ?

HARPAGON. Retire-toi, te dis-je, et ne m'échauffe pas les oreilles. (*Seul.*) Je ne suis pas fâché de cette aventure, et ce m'est un avis de tenir l'œil plus que jamais sur toutes ses actions.

SCÈNE IV.

FROSINE, HARPAGON.

FROSINE. Monsieur . . .

HARPAGON. Attendez un moment. Je vais[127] revenir vous parler. (*A part.*) Il est à propos[128] que je fasse un petit tour à mon argent.

SCÈNE V.

LA FLÈCHE, FROSINE.

LA FLÈCHE (*sans voir Frosine*). L'aventure est tout à fait drôle. Il faut bien qu'il ait quelque part un ample magasin de hardes ; car nous n'avons rien reconnu au mémoire que nous avons.

FROSINE. Hé ! c'est toi, mon pauvre La Flèche ! D'où[129] vient cette rencontre ?

LA FLÈCHE. Ah ! ah ! c'est toi, Frosine ; que viens-tu faire ici ?

FROSINE. Ce que je fais partout ailleurs ; m'entremettre d'affaires, me rendre serviable aux gens, et profiter du mieux qu'il m'est possible des petits talens que je puis avoir. Tu sais que dans ce monde il faut vivre d'adresse et qu'aux personnes comme moi le ciel n'a donné d'autres rentes que l'intrigue et que l'industrie.

LA FLÈCHE. As-tu quelque négoce[130] avec le patron du logis ?

SCENE III.

HARPAGON, CLÉANTE.

HARPAGON. It is you who want to ruin yourself by such blamable loans ?

CLÉANTE. It is you who try to enrich yourself by such a criminal usury ?

HARPAGON. Do you dare after that to appear before me ?

CLÉANTE. Do you dare after that to appear in society ?

HARPAGON. Are you not ashamed, tell me, to indulge in such disorders, to rush into frightful expenses ? and to shamefully squander the fortune which your parents have got for you with so much trouble ?

CLÉANTE. Do you not blush at dishonouring your station in life by the trade you carry on ? at the sacrifice of your glory and reputation to your insatiable desire to heap crown upon crown ? and to surpass, in the matter of interest, the most infamous subtleties (cunning) that the most renowned usurers ever devised ?

HARPAGON. Get out of my sight, rogue ; get out of my sight !

CLÉANTE. Which is the more criminal, in your opinion, he who buys a sum of money which he requires, or else he who steals a sum of money of which he has no need ?

HARPAGON. Go away, I tell you, and do not provoke me. (*Alone.*) I am not sorry for this adventure, and it is a hint to keep my eye more than ever on all his actions.

SCENE IV.

FROSINE, HARPAGON.

FROSINE. Sir . . .

HARPAGON. Wait a little. I am coming back to speak to you. (*Aside.*) It is proper that I should pay a visit to my money.

SCENE V.

LA FLÈCHE, FROSINE.

LA FLÈCHE (*without seeing Frosine*). The adventure is quite funny. He must indeed have somewhere a large store of clothes ; for we recognised nothing in the list we have.

FROSINE. Hallo ! is that you, my poor La Flèche ? How come we to meet ?

LA FLÈCHE. Ha ! ha ! is that you, Frosine ? what do you come here for ?

FROSINE. What I do everywhere else ; to meddle with business, to make myself useful to (to oblige) people, and profit as best I can by the few talents I may have. You know that in this world we must live by our wits, and that heaven has given to persons like me no other income than intrigue and skill.

LA FLÈCHE. Are you doing any business with the master of the house ?

(126) *Ou* is unnecessary here, but was put in to establish a stronger contrast between the two persons.

(127) *Je vais revenir.* When the verb *aller* is immediately followed by an infinitive, it is used to point out a proximate future.

(128) *A propos* often means 'in the nick of time.'

(129) *D'où vient cette rencontre?* literally 'whence comes this meeting?'

(130) *Négoce* has grown obsolete, though *négociant* is the name by which successful tradesmen prefer to be called.

FROSINE. Oui, je traite pour lui quelque petite affaire, dont j'espère une récompense.

LA FLÈCHE. De lui? Ah! ma foi, tu seras bien fine, si tu en tires quelque chose; et je te donne avis que l'argent céans est fort cher.

FROSINE. Il y a de certains services qui touchent[131] merveilleusement.

LA FLÈCHE. Je suis votre valet,[132] et tu ne connais pas encore le seigneur Harpagon. Le seigneur Harpagon est, de tous les humains, l'humain le moins humain,[133] le mortel, de tous les mortels, le plus dur et le plus serré. Il n'est point de service qui pousse sa reconnaissance jusqu'à lui faire ouvrir les mains. De la louange, de l'estime, de la bienveillance en paroles, et de l'amitié, tant qu'il vous plaira; mais de l'argent, point d'affaires. Il n'est rien de plus sec et de plus aride que ses bonnes grâces et ses caresses: et *donner* est un mot pour qui[134] il a tant d'aversion, qu'il ne dit jamais *Je vous donne*,[135] mais *Je vous prête le bonjour*.

FROSINE. Mon Dieu, je sais l'art de traire les hommes! J'ai le secret de m'ouvrir leur tendresse, de chatouiller leurs cœurs, de trouver les endroits par où ils sont sensibles.

LA FLÈCHE. Bagatelles ici. Je te défie d'attendrir, du côté de l'argent, l'homme dont il est question. Il est Turc là-dessus, mais d'une turquerie[136] à désespérer tout le monde; et l'on pourrait crever, qu'il n'en branlerait pas. En un mot, il aime l'argent plus que réputation, qu'honneur et que vertu; et la vue d'un demandeur lui donne des convulsions. C'est le frapper par son endroit mortel, c'est lui percer le cœur, c'est lui arracher les entrailles, et si . . . Mais il revient; je me retire.

SCÈNE VI.

HARPAGON, FROSINE.

HARPAGON (*bas*). Tout va comme il faut. (*Haut.*) Eh bien, qu'est-ce, Frosine?

FROSINE. Ah, mon Dieu! que vous vous portez bien! et que vous avez là un vrai visage de santé!

HARPAGON. Qui, moi?

FROSINE. Jamais je ne vous vis un teint si frais et si gaillard.

HARPAGON. Tout de bon?

FROSINE. Comment! vous n'avez de votre vie été si jeune que vous[137] êtes; et je voi des gens de vingt cinq ans qui sont plus vieux que vous.

HARPAGON. Cependant, Frosine, j'en ai soixante bien comptés.

FROSINE. Hé bien! qu'est-ce que cela, soixante ans? voilà bien de quoi! C'est la fleur de l'âge, cela; et vous entrez maintenant dans la belle saison de l'homme.

HARPAGON. Il est vrai; mais vingt années de moins, pourtant, ne me feraient point de mal, que je croi.[138]

FROSINE. Yes, I am managing for him some little transaction for which I hope to receive some reward.

LA FLÈCHE. From him? Ah! upon my word, you will be very clever if you get anything from him; and I warn you that money is very dear here.

FROSINE. There are certain services which move wonderfully.

LA FLÈCHE. I am your servant, and you do not yet know Mr. Harpagon. Mr. Harpagon is, of all men, the least human being, the harshest and most close-fisted mortal of all mortals. There is no service which moves his gratitude so far as to make him loosen his purse strings. Praises, esteem, kind words, and friendship, as much as you please; but as for money, none. There is nothing more dry and barren than his good graces and caresses; and *to give* is a word for which he has so great an aversion that he never says *I give you*, but *I lend you* good day.

FROSINE. Dear me; I know the art of fleecing men. I have the secret of rousing their kindness, of tickling their hearts, of finding their weak points.

LA FLÈCHE. Trifles here. I defy you to soften, in money matters, the man of whom we are speaking. He is a perfect Turk in that matter, but of a harshness to make everybody despair; and one might die, yet he would not stir. In one word, he loves money more than reputation, honour, and virtue; and the sight of an asker gives him convulsions. It is striking him on his vital point, it is piercing his heart, it is killing him, and if . . . But he is coming back; I withdraw.

SCENE VI.

HARPAGON, FROSINE.

HARPAGON (*in a low tone*). Everything is going on as it should. (*Aloud.*) Well, what is it, Frosine?

FROSINE. Oh, dear me! how well you are! and how well your face shows you are in perfect health!

HARPAGON. Who? I?

FROSINE. I never saw you with so fresh a complexion, and so lively.

HARPAGON. Do you speak seriously?

FROSINE. What! You never were so young in your life as you are; and I see people of twenty-five who are older than you.

HARPAGON. Yet, Frosine, I am quite sixty.

FROSINE. Well, what is that?—sixty! A fine thing to make a fuss about! *That* is the prime of life; and you are now entering the fine part of a man's life.

HARPAGON. That is true; yet twenty years less would do no harm, I think.

(*To be continued.*)

(131) *Touchent* may equally well be rendered by 'touch.'

(132) *Je suis votre valet* is here equivalent to a strong negative.

(133) This repetition of the word *humain* is not to be imitated, because the two first are nouns, and the last is an adjective.

(134) *Pour qui* is now only said of persons; we now say *pour lequel*.

(135) *Je vous donne le bonjour*, we would rather say *je vous souhaite le bonjour*.

(136) *Turquerie* was coined for the sake of emphasising the word *Turc*.

(137) *Vous êtes*. As the word *jeune* is understood, its place should now be supplied by *le*: *vous l'êtes*.

(138) *Que je croi*, instead of *que je croie*, a license formerly indulged in by playwrights and poets.

OUR 1893 CERTIFICATE CLASS.

BY DR. GEORGE BEACH, M.A.

Co-Author of a 'Manual of our Mother Tongue,' 'A Girls' Arithmetic,' Author of 'Elements of English,' 'Entertaining Readers,' etc.

I. Model Answers to School Management.

Certificate Examination, 1892.

First Year (*Men and Women*).

Candidates must not answer more than *five* questions from either Section, or more than *eight* questions in all.

N.B.—If you answer more than the prescribed number of questions, only that number of answers coming first on your paper will be revised.

Section I.

1. Write out full notes of a lesson on one of the following topics, showing (*a*) for what class of scholars it is intended, (*b*) what visible illustration would be required, and (*c*) what is the educational object aimed at.

(i.) Reduction to a Common Denominator.
(ii.) Fisheries.
(iii.) The manufacture of *either* Iron *or* Porcelain.
(iv.) Colour (*for Infants*).

i. Reduction to a Common Denominator.

This lesson is for Standard V., and may be illustrated by diagrams on blackboard, by a footrule divided into thirds, fourths, and twelfths of inches, and by half-crowns, florins, shillings, pence, etc. The educational object is that of teaching that two dissimilar but kindred things may be compared through the medium of a third.

A. *Groundwork of lesson* :—

(*a*) A '*denominator*' is the name of anything. More correctly, the word should be '*denomination*.' Thus, in the term '*one shilling*,' '*shilling*' is the denomination of the number *one*. The word '*denominator*' is used in Vulgar Fractions only, and specifies the value of each unit of the numerator as a fraction of unity. In the expression three-fourths (written $\frac{3}{4}$), the denominator '4' shows that each unit in the denominator '3' is a fourth of *one*.

(*b*) Every fraction can be expressed in an infinite number of ways, provided always that the ratio between the numerator and denominator remains constant. Thus, $\frac{3}{4} = \frac{6}{8}$, $\frac{9}{12}$, $\frac{900}{1200}$, etc. This is effected by multiplying or dividing the numerator and denominator by the same number.

(*c*) When two or more fractions have the same denominator or name, this denominator is said to be *common* to both. $\frac{1}{3}$ and $\frac{2}{3}$ have the same denominator, so that we call 3 the *common denominator*.

B. Use of a Common Denominator.

Concrete numbers of various kinds can seldom be usefully added together, for what would their denomination be? 1s. + 2d. would equal, not 3s., not 3d., but merely 3 coins. Similarly, $\frac{2}{3} + \frac{2}{5}$ would not equal $\frac{5}{8}$ or $\frac{4}{7}$ or $\frac{4}{15}$, but 5 *parts* only. Reduction to a common denomination must therefore take place, and when *two* fractions only are employed, this may be effected by taking the product of the denominators as the new and common denominator. Then $\frac{2}{3}$ would $= \frac{10}{15}$ and $\frac{2}{5}$ would $= \frac{10}{15}$, for by whatever multiple the denominator be increased, by that multiple must the numerator be increased.

C. *Exercises*—

Reduce to common denominators—

(*a*) $\frac{1}{2}$, $\frac{1}{3}$; (*d*) $\frac{3}{4}$, $\frac{3}{5}$;
(*b*) $\frac{1}{3}$, $\frac{2}{5}$; (*e*) $\frac{1}{5}$, $\frac{2}{7}$;
(*c*) $\frac{2}{3}$, $\frac{3}{4}$; (*f*) $\frac{3}{7}$, $\frac{5}{8}$.

D. *Cautions, etc.*—

(*a*) The above is quite enough for a First Lesson.
(*b*) The *Least* Common Multiple was not asked for.

2. Frame three sets of questions in Arithmetic, suited for the examination of scholars in the Third, Fourth, and Fifth Standards respectively, so as to test knowledge of the reason for rules as well as of their application to practice.

A. *Standard III.*

(1) A horse and cart cost £15 17s. 6d., the harness cost £3 6s. 8d. The cart cost £2 1s. 3d. more than the harness. What did the horse cost? Ans. £10 9s. 7d.

(2) There are 51,057 cabbages planted in 27 rows. How many would there be in each row? Ans. 1,891.

(3) Add together £3 4s. 2d. four times. Ans. £12 16s. 8d.

(4) How many miles an hour does a swallow travel who flies 2,286 miles in 18 hours? Ans. 127 miles.

B. *Standard IV.*

(1) How many more pence than shillings are there in £5 17s.? Ans. 1,287.

(2) How much money would I require to give 312 men £14 8s. 1d. each? Ans. £4,494 2s. 0d.

(3) How many bags, each containing 3 galls. 3 qts. will it take to hold 16 qrs. 7 bhls.? Ans. 288 bags.

(4) Share £10,001 5d. 0d. equally among 200 men and 100 women. Ans. £33 6s. 9d.

C. *Standard V.*

(1) How much nearer to a whole number is $\frac{4}{5}$ than $\frac{1}{3}$. Ans. $\frac{2}{15}$.

(2) What is the value of $233\frac{3}{4}$ pigs at £3 3s. 3d. per pig? Ans. £738 19s. 5d.

(3) Find the length of 320 lines, each 3 miles, 7 furls., 39 poles long. Ans. 1,279 miles.

(4) 27 men eat 216 loaves in 32 days, how long will it take 16 men to eat them? Ans. 54 days.

N.B. *See also Dr. Beach's Daily-Working Test Cards.*

3. i. What are the tests of good reading? ii. Discuss the importance and usefulness (*a*) of Pattern Reading, (*b*) of Silent Reading, (*c*) of Simultaneous Reading.

i. The chief tests of good reading are :—
(*a*) Absolute accuracy of pronunciation.
(*b*) Clearness of articulation.
(*c*) Suitable rate of rendering.
(*d*) Full appreciation of meaning.
(*e*) Elocution bordering upon declamation where admissible.

ii. (*a*) Pattern Reading is essential for imitative purposes, but should not be too prolonged.

(*b*) Silent Reading should be private study of the matter, meaning, and spelling, but is apt to be useless to lazy scholars and to engender inaccuracy unless the lesson has been previously gone over by the teacher.

(*c*) Simultaneous Reading is of immense use in affording much practice, in training the tone and pitch of the voice, in regulating punctuation and rate, and in banishing shame-facedness. Great care is, however, necessary to prevent carelessness of pronunciation and articulation, and a dull level of style.

4. Give what you consider a suitable time table for the studies and employments of a pupil-teacher in his or her third year.

See our Pupil Teacher's Course.

5. i. Grammar has been sometimes defined as the 'art of speaking and writing the English language with propriety.' How far does this definition appear to you to be true or adequate? ii. By what expedients, other than the teaching of technical grammar, is it possible to enrich a scholar's store of words, and to encourage precision in the use of them?

i. This definition confuses the Science of Grammar with the Art involved in its application. Moreover it refers only to English and ignores every other language, and also comparative grammar, and neglects the educational and logical side of the science.

ii. The scholars' vocabulary is chiefly augmented by reading, wherein, in many instances, the context will explain a new word. By the acquisition of the most common Saxon, Latin, and Greek roots, many words may be added and 'understanded.'

6. In criticising a lesson given by a teacher, what are the special points to which attention should be directed? Give some rules as to pupil-teachers, to help them in judging of merits and defects, and in forming a just estimate of the success of a lesson.

See Model Answers to Queen's Scholarship Questions in our August 1891 issue.

7. i. Describe the chief characteristics of the methods of Fröbel; ii. and say how those methods might be most effectively employed (*a*) in the lower class of infants, (*b*) in a class of children of the average age of 10.

i. Fröbel endeavoured to stimulate self-development by sounding within the child 'the triple chord of living, acting, and conceiving,' by guiding 'the formative and creative instinct, and by utilising the restlessness or spontaneous action of children.'

ii. (*a*) Infants must be allowed to develop on their own lines, to search out and investigate the more common circumstances of their surroundings, and the child nature being conformed with must expand as a plant in a garden. Form, colour, and number greatly engage the attention of an infant outside school, and in systematic graduation should pleasurably occupy him within school. He should handle, see, and listen to many familiar objects, and as far as possible find out properties for himself, the teacher affording opportunities for conception, rather than himself implanting.

(*b*) The ten year olds may be treated somewhat differently. They will be more disciplined and capable of more concentration and abstraction, yet should every subject be treated as concretely as possible. Their money and weights and measures sums (for instance) should be realistically treated, and the actual operations of adding, subtracting, dividing, weighing, measuring, etc., be gone through.

Until the present codal conditions are abrogated much more cannot be achieved.

Section II.

8. i. What is the difference between voluntary and involuntary attention? ii. (*a*) Give some examples of both, and (*b*) of the conditions under which the power of fixing and concentrating the attention of scholars may best be strengthened.

i. Attention is at first entirely involuntary and always remains to some extent independent of the will. Any striking sight, sound, etc., excites by an external impression involuntary attention. Voluntary attention is an act of the will and preliminary to 'observation.' It may be called an intensified consciousness.

ii. (*a*) Anything that forcibly appeals to the senses, such as a light waved before a baby, arouses involuntary attention, (*b*) whilst anything that puzzles, is difficult of comprehension, develops voluntary attention.

(*b*) Voluntary attention must be produced in the natural order of growth. Full use must be made of objects and circumstances calculated to arrest the attention of themselves. As many senses as possible must be appealed to.

Then the external excitement may be gradually withdrawn as the will becomes more and more induced.

See also Cartwright's 'Mental Science,' p. 187.

9. What do you regard as the special disciplinal and educational value—apart from their practical usefulness—of (1) mental arithmetic, (2) of geography, (3) of logical analysis, and (4) of Fröbelian exercises in drawing.

(1.) Mental arithmetic strengthens the power of concentration, calculation, and abstraction, and helps to create pictorial memory.

(2.) Geography trains the memory and enlarges the mind and area of thought. It stimulates the imagination, brings into play observation, and broadens the sympathies.

(3.) Logical analysis teaches us how to think and in some measure prevents false conclusions; it will chasten a too vivid imagination, conduce to accuracy, and in general preaches the reign of law.

(4.) Fröbelian exercises in drawing arouse a sense of order and regularity, develop the artistic sense, and incite to independent investigatory or creative efforts.

10. 'A *pen* to register; a *key*
That winds through secret wards,
Are well assigned to Memory
By allegoric bards.
As aptly also might be given
A *pencil* to her hand;
That softening objects, sometimes even
Outstrips the heart's demand.'—*Wordsworth.*

How far do any of these metaphors accurately describe the nature and functions of Memory? Give reasons for your answer.

The metaphors employed are three: (*a*) of a *pen*, (*b*) of a *key*, and (*c*) a *pencil*.

(*a*) *A pen.* Memory registers and records: this is its primitive and essential function.

(*b*) *A key.* Memory unlocks old remembrances. The *secret wards* may be represented by the hidden 'principles of association,' which assist in recalling past events.

(*c*) *A pencil.* Time softens the outlines of sorrow and beautifies those of pleasure. This is well exemplified by the world-wide fallacy that the 'brave days of old' were better than the present time. Memory performs the same office as time.

11. i. Distinguish between apprehension and comprehension; and ii. between perception and conception, and iii. show the bearings of these distinctions on the work of a teacher.

i. Apprehension is the understanding of a thing by itself and apart from its connection with other things. Comprehension includes not only apprehension, but an appreciation of the connection of the thing with its correlatives.

ii. Perception is the externalising of sensations both present and past. Conception is the power of forming a general notion by means of combining and rejecting certain percepts.

iii. Apprehension and perception have more to do with the acquisition of knowledge; comprehension and conception prepare this knowledge ready for application. A teacher cannot assist a scholar to comprehend and conceive unless that scholar has first apprehended and perceived.

Apprehension and perception are (so to speak) more concrete and particular than comprehension and conception, which are more abstract and general. The teacher must therefore employ the concrete before the abstract, and the particular before the general.

12. It is said that in teaching young children, 'presentation' should precede 'representation.' i. What does this mean? and ii. What light does this dictum throw on the method of giving an object lesson?

i. Presentation, or the actual exhibition of an object, must precede representation or the symbolic suggestion of the object. Indeed, unless either the object or one of its genus has been presented, representation cannot be effected.

ii. This dictum truly declares that object lessons must not be given, if possible, without the objects themselves, and that models are more valuable than pictures, and pictures than verbal representation.

Presentation conforms more to the Fröbelian principles of self-development and utilisation of the spontaneous activities.

All the more obvious properties of an object, those discernible by the senses, must be first treated of, and afterwards those more latent, and the uses and applications of the object.

13. J. P. Richter says, 'Let us respect the happiness of children.' Say in what way it is possible for a teacher, either of infants or of older children, to give effect to this counsel without diminishing the efficiency of the school as a place for serious work.

The happiness of school-children may be promoted without diminishing school efficiency by the teacher

(*a*) Not imposing unnecessary rules;

(*b*) Cultivating the voluntary attention and training the will, so that application may be due rather to internal disposition than external authority;

(*c*) Utilising emulation and rewards instead of too frequent or heavy punishment—inciting rather than compelling;

(*d*) Studying the character and idiosyncracy of each scholar;

(*e*) Allowing sufficient and corporeal exercise; and by

(*f*) Varying the lessons so as to lessen the strain upon any given mental faculty.

II. Mental Arithmetic (1892).

1. $17 + 29 + 18 + 16 - (27 - 9)$.

2. Take a third, a fourth, and a fifth of a sovereign from a sovereign, and say what sum of money is left.

3. What is the square root of 4,096?

4. Multiply 1,674 by 99.

5. Add the square of 27 to the square of 13.

6. Find the price of $3\frac{1}{2}$ pounds of tea at 2d. per oz.

7. Express in pounds, shillings, and pence (approximately and to farthings only) the following amounts:—£17·35, £7·525, £1·67.

8. Express decimally to the third place the following sums:—£2 5s. 6d., 15s. 6d., £5 3s. 9d.

9. What is the price of 5 gross of articles at 3¾d. each?

10. Find the numbers needed to complete the statement of proportion :—

( ) : 42 :: 5 : 35,
56 : ( ) :: 320 : 40,
340 yds. : 8½ yds. :: 80 : ( ).

11. Find the interest on £260 for 3 years 5 months at 5 p.c.

12. Find the price of 880 yards at 2s. 6½d. per yard.

13. Find the number of minutes in a day and a half.

14. How many lengths of ribbon, each 3½ inches, could be cut from a piece measuring 26 yards?

Answers. (1) 62; (2) 4s. 4d.; (3) 64; (4) 165,729; (5) 898; (6) 9s. 4d.; (7) £17 7s., £7 10s. 6d., £1 13s. 4½d.; (8) £2·275, £·775, £5·188 nearly; (9) £11 5s.; (10) 6, 7, 2; (11) £48 15s.; (12) £111 10s. 8d.; (13) 2,160; (14) 288.

III. Conclusion of Government Questions already set respecting the Eighteenth Century (*continued from p.* 45).

91. What were the chief writings of Dr. Johnson, and who were his chief friends and associates? (1886.)

92. Sketch shortly the careers of one English Statesman, one English Admiral, and one English Soldier, who figured conspicuously in the European struggle which arose out of the French Revolution. Give dates. (1890.)

93. Who are the chief Englishwomen who have influenced English politics and thought during the eighteenth century? (1890.)

94. How did Walpole prepare the way for Pitt? (1889.)

95. What do you understand by the phrase '*The Hundred Years' War for the Possession of the New World*'? (1889.)

96. What was the importance of the battles of Cape St. Vincent, Camperdown, and Copenhagen? Give a careful account of them, with plans and dates. (1891.)

97. What was the main provision of Fox's Libel Bill? Mention any trials in which this alteration of the law proved of great importance? (1891.)

98. Give a short sketch of the industrial development of England at the end of the last century. (1891), (1892).

99. What were the effects on the political history of the time of Burke's '*Reflections*,' Smith's '*Wealth of Nations*,' and T. Paine's '*Rights of Man*'? (1891.)

100. Name the leading poets who lived and wrote at the end of the eighteenth century, and the most important work of each. Describe any one of these. (1891.)

101. Say in what way the French Revolution affected the literary history of the period, mentioning especially the view taken of that event by Wordsworth, Southey, Coleridge, and Burke respectively. (1892.)

IV. Items.

(*a*) The names of all certificate candidates not being students in any Training College, must be notified to the Department before the first of October next. This should be attended to at once.

(*b*) According to the Syllabus, Second Year Women, First Year Women, First Year Men, *can*, but Second Year Men *cannot*, take Language as an extra subject.

(*c*) It was quite plainly set forth in our last issue that Second Year Men could take Science as a group, (*d*) or (*f*), and claim marks for the same sciences as did duty last year.

(*d*) The practical part of music can be taken in one notation, and the theoretical in another.

(*e*) Although Euclid's proofs are not required, the order of his propositions must be observed. For instance, no proposition equivalent to No. 6 would be allowed to be demonstrated by the principles of Euclid's No. 7.

(*f*) Substantive Verbs are a species of Copulative Verbs. All verbs of this class take the same case after as before.

(*g*) Verbs like *can, could, shall, should, will, would, tell, told*, are not Regular, although their First Definite Tense ends in '*d*.'

(*h*) *Paradise Lost, Book I., Lines* 507 *to* 521.

Subj.	Predicate.	Object.	Kind of Sentence.
1. To tell the rest	were long		Principal
2. Though the Ionian gods . . . younger Saturn	[were] far renowned		Principal
3. He	found, from mightier Jove . . . son	like measure	Principal
4. Jove usurping [so]	reigned		Adverbial to 3
5. These, known first in Crete and Ida . . . . . cold Olympus . . . . Doric land	ruled	the middle air . . . heaven	Principal
6. Who	fled with Saturn . . . . fields		Adjective to *rest*.

We have only inserted a simple form of Analysis, the more complex can be easily compiled therefrom.

V. The difficult words to be parsed from Routine are as follows :—

First Year.

(*a*) Men. *Since, had dared, except, knew, was, dead, forth, sudden, as, thing, taken, which, this, grasping, beside, but.* (First Friday.)

(*b*) Men. *Then, sprang, house, song, merry, as, being, all, only, proven, boy, so, that, that, but, Lynette :* or

Women. *First, farthest, chaos, to retire, as, foe, that, Satan, now, like, vessel, though, torn.* (Third Monday.)

Second Year.

(*c*) Men. See (*a*), or

Women. *Haste, to hear, noblest, for, me, which, doth, also, whose, more, performed, even, lest, errors.* (First Wednesday.)

(*d*) See (*b*), or

Women. *Good, he, why, watch, subject, mart, such, whose, divide, what, might, toward that, joint-labourer, can.* (Fourth Monday.)

VI. Any of our Papers marked as follows :—weekly 1s. 6d.; monthly 5s. 6d.; quarterly 15s. 9d. Address Dr. G. Beach, M.A., Macclesfield.

SELECTED GOVERNMENT QUESTIONS.

FIRST YEAR.

Second Week.

1. Write in *Large-hand* the words '*Gymnastic Exercises.*'
Write in *Small-hand* the words '*Their furrow oft the stubborn glebe has broke.*'

2. Write from Dictation :—
'To be habituated to different sentence arrangements must be rather obstructive than otherwise. The reference to any other language can only be a matter of curiosity. If it ever

happened that our language could borrow an effective arrangement of syntax from any other language, the borrowing should have taken place once for all, so that all succeeding ages might adopt it as a naturalized usage.'

3. Show how a habit of close observation of the distinctive characteristics of objects presented to young children may be most effectually cultivated.

4. Make a short sketch of a lesson for a senior class on the Moral Uses of Games, or for a junior class on Truthfulness.

5. Bar the following passages in accordance with the time signatures :—

Fill up two measures of each of the following kinds, showing rests and continuations in each example :—(*a*) Two-pulse, (*b*) Four-pulse, (*c*) Three-pulse.

6. State the meanings of the following terms, and give the words that express the opposite meanings :—(*a*) Diminuendo, (*b*) Piano, (*c*) Staccato, (*d*) Accelerando.

7. (*Men only.*) Explain the following passages :—(*a*) 'O purblind race!' (*b*) 'Far liefer had I die,' (*c*) 'Into many a listless annulet she wove it,' (*d*) 'Two wild men supporters of a shield,' (*e*) 'The host suddenly honest answered.'

(*Women only.*) (*a*) 'My sentence is for open war,' (*b*) 'Which will reduce to nothing this essential,' (*c*) 'Belial, in act more graceful and humane,' (*d*) 'What can force or guile with him?' (*e*) 'The parching air burns frore.'

8. See Routine, Third Week, Monday.

9. Draw a map of China, marking in mountains, rivers, and productions.

10. Explain clearly the causes of the ebb and flow of the tide; and the peculiarity of the spring and neap tides.

11. Give dates of battle of Bosworth, discovery of America, battle of Flodden, battle of Pinkie, martyrdom of Cranmer.

12. (*Men only.*) Give some account of the writings of Addison, Steele, and Swift. Compare the periodical literature of Queen Anne with that of the present day.

(*Women only.*) What do you know of the wives of Henry VIII?

13. A boat with 2,720 sq. ft. of sails spread, travels 51 knots in $8\frac{1}{2}$ hours when the wind gives a pressure of ·125 lbs. per sq. ft. How far will it go in $2\frac{3}{4}$ hours with a sail area of 7,650 sq. ft., and a wind pressure of ·5 lbs. per sq. ft., assuming the speed to be proportioned to the area of the sail and the wind pressure?

Ans. 180 knots.

14. At what rate per cent. Simple Interest will £4317 10s. amount to £5019 1s. in 4 years 4 months? Ans. $3\frac{3}{4}$ per cent.

15. (*Men only.*) Find to the nearest foot the diameter of a circle whose radius equals half an acre. Ans. 166 ft.

(*Women only.*) Describe the constituents of milk, and explain why it is called a perfect food.

16. (*Men only*). Resolve into elementary factors :—

(*a*) $x^2-3x-130$. Ans. $(x+10)(x-13)$.

(*b*) x^4-81. Ans. $(x^2+9)(x+3)(x-3)$.

(*c*) $a^2(b-c)+b^2(c-a)+c^2(a-b)$.

Ans. $(a-b)(c-a)(c-b)$.

(*Women only.*) Explain the structure and function of the teeth, and give some rules for their preservation.

17. (*Men only.*) Prove the rule for finding the G. C. M. of two algebraical expressions, and find the L. C. M. of x^2-3x+2; x^2-5x+6; and $x^2-7x+12$.

Ans. $x^4-10x^3+35x^2-50x+24$.

(*Women only.*) How far, and in what way, can a school be helpful in enabling children to mend and preserve their own clothes?

18. (*Men only.*) Write out Euclid III., 27.

Through a given point within a circle draw a chord which shall be bisected in that point, and prove it to be the least.

(*Women only.*) What are the different purposes served by food? Name in regard to each of these purposes some one kind of food which is particulaly valuable.

19. (*Men only.*) Write out Euclid I., 7.

If one angle of a triangle be equal to the sum of the other two, the greatest side is double of the distance of its middle point from the opposite angle.

(*Women only.*) Explain the nature of the injuries caused by (1) high heels, (2) pointed shoes, and (3) tight lacing.

FIRST YEAR.

FOURTH WEEK.

1. Write in *Large-hand* the words '*Xenophon's Anabasis.*'

Write in *Small-hand* the words '*The quick brown fox jumps over a lazy dog.*'

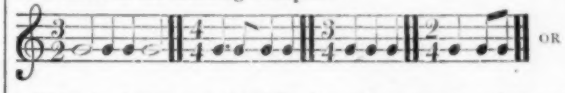
2. Write from Dictation :—

'The explanation and exemplification of the various terms employed, and of the rules and principles of composition, would seem to indicate with sufficient clearness the course to be pursued in the higher department of composition. Still, there is a certain latitude in the choosing of exercises, and the practice of teachers is very various in that respect. We may, therefore, offer a few words on that point. In the case of young pupils, there are very strong objections to Essay or Theme writing.'

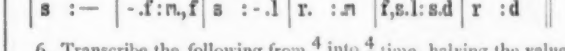
3. What are the principal objects of the promoters of '*Technical Education*'? How can the objects contemplated be promoted in the lower classes of a school for older children?

4. Point out the value of model lessons, and the abuses to which the repetition of the same lesson by other teachers is liable.

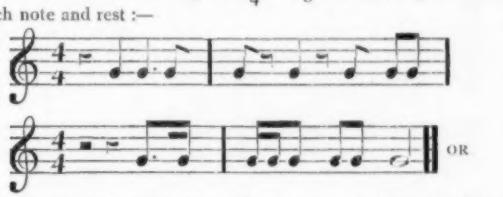
5. Place a mark (†) over the notes that should be strongly accentuated in the following examples :—



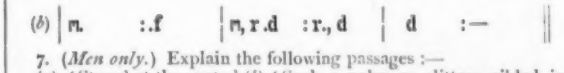
Write in figures over the following their value (in pulses and fractions of a pulse) of each note and rest :—



6. Transcribe the following from $\frac{4}{4}$ into $\frac{4}{8}$ time, halving the value of each note and rest :—



Rewrite the following in four-pulse measure, doubling the value of each note and rest :—



7. (*Men only.*) Explain the following passages :—

(*a*) 'Stared at the spate,' (*b*) 'Such a palm as glitters gilded in thy Book of Hours,' (*c*) 'Only changeling out of fairyland,' (*d*) 'All her dress wept from her sides,' (*e*) 'The dragon-boughts and elvish emblemings began to move.'

(*Women only.*) (*a*) 'The Aonian mount,' (*b*) 'This empyreal substance cannot fail,' (*c*) 'Our faithful friends lie thus astonished on the oblivious pool,' (*d*) 'Yet to their general's voice they soon obeyed,' (*e*) 'Than whom a spirit more lewd fell not.'

8. Analysis of First Friday. See Routine.

9. Describe the boundaries of Hindostan. Name the principal passes by which the North-West mountain ranges may be crossed, and the difficulties attending their passage.

10. Describe in words the course of the Indus. Sketch map may be added.

11. What was the foreign policy of Queen Elizabeth? Illustrate your answer by reference to actual measures adopted.

12. (*Men only.*) Describe the Assiento Contract.

(*Women only.*) Give some account of Sir Walter Raleigh, Sir Edward Coke, and Lord Bacon.

CERTIFICATE ROUTINE FOR AUGUST 1893 (MEN AND WOMEN, FIRST YEAR).

DAYS	FIRST WEEK.			SECOND WEEK.			THIRD WEEK.			FOURTH WEEK.		
	I.	II.	III.	I.	II.	III.	I.	II.	III.	I.	II.	III.
MONDAY	The effective range of Corporal Punishment and Detention.	Read 'Trench,' Lecture VI., *or* pp. 26 to 50 of Johnson's 'Milton'	Euclid, Book III., Props. 1 to 8, *or* Cost of Clothing	How to secure Good Repetition	Study Notes to 'Geraint and Enid,' *or* Johnson's Milton,' pp. 92 to 108.	Euclid, Book III., Props. 9 to 15, *or* Composition and Use of Air	Notes of a Lesson on Subordinate Sentences	Analyse lines 1386 to 1395 of 'Gareth and Lynette,' *or* Lines 1037 to 1044 of 'Paradise Lost,' Book II. Parse difficult words	Euclid, Book III., Props. 16 to 24, *or* 'Functions of Food'	How to develop 'Observation'	Study Notes of 'Gareth and Lynette,' *or* Grammar from Text-book	Euclid, Book I., Props. 1 to 16, *or* Functions of Clothing
TUESDAY	Chief Dates from 1783 to 1815	Harmonical Progression *or* Repair of Underclothing	Geography of S.E. Asia	Chief Dates from 1066 to 1189	Evolution of Algebra *or* Diagram of a Woman's Chemise	Stocks *or* Percentages	Poetry from 1789 to 1815 *or* Lives of Great Men from 1270 to 1376	Algebraic Surds *or* Any Needlework	Geography of Central Asia	Chief Dates from 1189 to 1274	Variation and Arithmetical Progression *or* Practise Needlework	Geography of Further India
WEDNESDAY	Present Worth and Discount *or* Practice.	Recitation and Penmanship	Equation of Payments *or* Simple Proportion	Stocks *or* Compound Proportion	Simultaneous Simple Equations *or* Recitations	Winds, Currents, and Tides	Any Revision *or* Notes on Johnson's 'Milton' pp. 92 to 107	Problems on Mixed Agents	Problems of Motion (Arithmetic)	Clock Sums	History of 18th Century Literature *or* Any School Management	Recitation and Penmanship
THURSDAY	History from 1800 to 1815	Involution of Algebra *or* Drainage and Water Supply	Extent and Population in Asia	History from 1066 to 1135	Algebraic Fractions *or* Composition and Nutritive Value of Food	Causes which affect Climate	Constitutional Affairs from 1660 to 1775	Ratio and Proportion of Algebra *or* Materials of Clothing	Geography of India	History from 1135 to 1216	Simple Equations *or* Furnishing the Home	Geography of Turkey in Asia
FRIDAY	Winds, Currents, and Tides.	Deductions of Euclid, Book III., *or* Cutting-out of a Pair of Drawers	Analyse lines 718 to 727 of 'Geraint and Enid,' and Parse difficult words, *or* Study notes to Johnson's 'Milton,' pp. 75 to 91	Mensuration *or* Fractions	Briefly write out the substance of 'Geraint and Enid,' *or* 'Paradise Lost,' Book I.	Rules for Teaching Elementary Freehand Drawing	The Principles of a School Routine and Classification	Euclid, Book II., *or* Furnishing of the Home	Read 'Trench,' Lecture IV., *or* pp. 51 to 79 of Johnson's 'Milton'	How to Illustrate Geography from the Scholars' Surroundings	Race Problems	Grammar from Questions
SATURDAY.	Standard Scale of Pitch and Relation of Musical Keys	Examination	Deductions of Euclid, Book I., *or* Construction of the Home	Map of Palestine	Examination	Deductions of Euclid, Book II., *or* Repair of Under-clothing	Chordal Structure of the Common Major Scale	Deductions of Euclid, Book III., *or* Diagram of an Infant's Shirt	Quadratic Equations, *or* Recitation	Composition on 'Better to wear out than rust out.'	Penmanship	Physical Map of China	Simultaneous Quadratics *or* Recitation	Composition on 'Self-development is the truest Education'

CERTIFICATE ROUTINE FOR AUGUST 1893 (MEN AND WOMEN, SECOND YEAR).

DAYS	FIRST WEEK.			SECOND WEEK.			THIRD WEEK.			FOURTH WEEK.		
	I.	II.	III.	I.	II.	III.	I.	II.	III.	I.	II.	III.
MONDAY	Jevons' Logic, pp. 22 to 37	Read 'Macbeth,' Act II. *or* 'Hamlet,' Act II.	Euclid, Book VI., first 8 Props., *or* Practise Darning	School Registers	Read First Half of 'Gareth and Lynette' *or* pp. 40 to 55 of 'Advancement of Learning'	Euclid, Book VI., first 17 Props., *or* Tucking, Whipping, Feather-Stitching	Notes of a Lesson on 'The Eye: its structure and uses'	Deductions on Euclid, Book VI., *or* Linen Patch	Paraphrase Lines 35 to 47 of 'Macbeth,' Act V., Scene 8 *or* Lines 4 to 19 of 'Hamlet,' Act V., Scene 2	'Herbert Spencer,' pp. 56 to 74, *or* 'Quick,' Chapter XVIII.	Euclid, Book II. *or* Print Patch	Analyse Lines 1386 to 1395 of 'Gareth and Lynette' *or* Lines 70 to 79 Act I., Scene 1, 'Hamlet,' Parse difficult words
TUESDAY	Chief Dates from 1783 to 1815 *or* History from 1547 to 1564	Mensuration *or* Stocks	As in First Year *or* Geography of Scotland	History from 1760 to 1774 *or* From 1584 to 1603	Race Problems *or* Any Arithmetic	As in first Year *or* Geography of Ireland	Chief Dates from 1066 to 1189 *or* Great Men from 1530 to 1584	Mental Arithmetic	As in First Year *or* Political Geography of Australia	History from 1774 to 1787 *or* Irish Affairs from 1485 to 1603	Theory of Proportion	As in First Year *or* Commercial Geography of Australia
WEDNESDAY	Analyse Lines 718 to 727 of 'Geraint and Enid' *or* Lines 389 to 398 of 'Hamlet,' Act V., Scene 2 Parse difficult words	Simultaneous Simple Equations *or* Food for the Sick	Peculiarities of Shakespeare's Grammar	Read Notes to 'Geraint and Enid,' pp. 91 to 116 *or* pp. 68 to 83 'Advancement of Learning'	'Herbert Spencer,' pp. 38 to 56 *or* 'Quick,' Chapter XVII.	The Algebraic Progressions *or* Apportionment of Small Incomes	Mensuration *or* Any Revision	Jevons' Logic, pp. 37 to 53	Algebraic Interest *or* Best time to purchase Household Requisites	Jevons' Logic, pp. 53 to 69	Algebraic Annuities *or* Disinfectants	History of Eighteenth Century *or* Any School-Management
THURSDAY	History from 1660 to 1685 *or* From 1564 to 1584	Compound Proportion	As in First Year *or* Political Map of Australia	History from 1685 to 1714 *or* Dates from 1530 to 1558	Compound Interest	As in First Year *or* Physical Geography of Australia	History from 1714 to 1744 *or* Foreign Policy of the Tudors	Problems of different agents (A, B, C, etc.) and of running taps	As in First Year *or* Manufactures of Scotland and Ireland	History from 1744 to 1774 *or* Great Men from 1584 to 1603	Stocks	As in First Year *or* Geography of New Zealand
FRIDAY	Binomial Theorem *or* Nourishing Foods for Convalescents	Deductions on Euclid, Book I. *or* Diagram of Muslin Pinafore	The Educational value of Drawing, and its relation to Writing	Permutations *or* Benefit Clubs, Building Societies, etc.	Deductions on Euclid, Book II. *or* Cutting-out of Muslin Pinafore	Mensuration *or* Division into Proportional Parts	Combinations *or* Slight Wounds and Accidents	Euclid, Books II. and IV. *or* Give the measurements of the required garments	Read second half of 'Gareth and Lynette' *or* Notes pp. 84 to 99 of 'Advancement of Learning'	Mensuration *or* Infection and Contagion	Principles of Euclid, Book V. *or* Describe how to cut out a Boy's Shirt	Paraphrase Lines 126 to 138 of 'Macbeth,' Act IV., Scene 7 *or* Lines 1 to 13 of 'Hamlet,' Act V., Scene 1
SATURDAY.	Transcription from one time to another	Examination	What are the leading objects of Macbeth *or* Hamlet?	As in First Year *or* Physical Map of Australia	Examination	Repetition, Literature, and Penmanship	Compass and registers of Voices	Mensuration *or* Proofs of Rules	Study of Code	Grammar from Questions	Penmanship	As in First Year *or* Map of New Zealand	Mensuration *or* Any Revision	Repetition, Literature, and Penmanship

13. The distance from London to Dover is 75 miles, from Dover to Calais 20 miles, and from Calais to Paris 180 miles, and I pay £2 17s. 6d. for my ticket. The rate per mile being by boat 2½ times more, and by French railway 2⅔ per cent. less than by English railway, find the respective shares of the two railways and the boat company. Answers. 13s. 5$\frac{23}{37}$d., 12s. 6$\frac{12}{37}$d., £1 11s. 5$\frac{1}{37}$d.

14. In a race of 100 yards A allows B 4 yards and C 6 yards start, in order that all three may reach the goal at the same time. How much start should B allow C, when B has to run the whole distance? Ans. 2$\frac{1}{13}$ yds.

15. (*Men only.*) A circle and an equilateral triangle have equal perimeters. Compare their areas. Ans. As 63 : 38·1.

(*Women only.*) How would you remove (*a*) ink stains, (*b*) fruit stains, (*c*) grease stains, and (*d*) paint from clothing?

16. (*Men only.*) Many pupil teachers when asked to prove a formula, simply give a numerical illustration. Explain why this is worthless.

Prove that a multiplied by $b = b$ multiplied by a, when a and b are any positive integers.

(*Women only.*) Why is it needful that bedrooms should be ventilated, and how may this object best be effected?

17. (*Men only.*) Find the square root of $x^6 - 8x^5 + 24x^4 - 34x^3 + 24x^2 - 8x + 1$. Ans. $x^3 - 4x^2 + 4x - 1$.

(*Women only.*) Give a few simple counsels to a pupil teacher upon diet, sleep, economy of strength, and adduce your reasons for such advice.

18. (*Men only.*) Write out Euclid III. 29.

Given two circles, it is required to find a point from which tangents may be drawn to each equal to two given straight lines.

(*Women only.*) What are arrowroot and Indian corn? What are the special qualities which fit them to be used as food, and how may they best be prepared for use?

19. (*Men only.*) Write out Euclid II. 4.

Show that in a parallelogram, the sum of the squares on the diagonals is equal to the sum of the squares on the sides.

(*Women only.*) Explain the use of eggs in cooking. How may they best be preserved for later use?

SECOND YEAR.

Second Week.

1. As in First Year.

2. As in First Year.

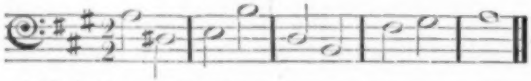
3. A boy comes to school for the first time on January 10th, and leaves the neighbourhood without expectation of return on March 10th. During these months he stays away on some days from illness, on others from truancy. On the 10th May he returns with the expressed intention of remaining for another year at school, but he goes out to work for the three summer months. Then he becomes recognised as a half-timer, and continues alternately at work and at school till he finally leaves on December 10th.

(*a*) Give all the entries that should be made for such a boy both in admission and class registers.

(*b*) Show how the average of a school whose meetings were 400 in number would be affected by the presence of 10 such boys attending for a period equivalent to 12 weeks each during the year.

4. What are the processes of thought involved in (*a*) the classification of objects; (*b*) the use of an abstract noun; and (*c*) the use of a syllogism?

5. Write the following in the treble clef (adding the key signature) to sound one octave higher :—



OR

Write in the Lah Mode (*a*) an *ascending* minor scale, using the minor or essential sixth, and the major or essential seventh, and (*b*) a *descending* minor scale, using the minor or occasional seventh and the minor or essential sixth.

6. Write the ascending scale of G minor and B minor, using the major sixth and the major seventh. Write the sharps or flats before the notes and not as a signature; OR,

Write the following intervals :—(*a*) Above *lah* an augmented sixth; (*b*) Above *se* a diminished third; and (*c*) Above *doh* an augmented fifth.

7. (*Men only.*) As in First Year.

(*Women only.*) What do you know of Tacitus, Plato, Epaminondas, Clement VII., Cicero, and Ixion?

8. Paraphrase from routine.

9. (*Men only.*) As in First Year.

(*Women only.*) Draw a map of the Irish Sea, giving capes and mouths of rivers.

10. (*Men only.*) As in First Year.

(*Women only.*) Describe the course of the Trent or the Murray.

11. (*Men only.*) As in First Year.

(*Women only.*) Give the dates of Statute of Fines, Poyning's Law, 'Intercursus Magnus,' Battle of Pavia, Disgrace of Wolsey, and Act of Supremacy.

12. (*Men only*). As in First Year.

(*Women only.*) What do you know of the Courts of '*Star Chamber*' and '*High Commission*'?

13. (*Men only.*) A tradesman buys goods at £20 per cwt., and sells them at 4s. 2d. per lb., but there is 5 per cent. waste. Find his profits per cent. Ans. 10$\frac{3}{8}$ per cent.

(*Women only.*) As in First Year.

14. (*Men only.*) What must be the market value of a 4 per cent. stock in order that after paying an income tax of 6d. in the £, it may yield 3¼ per cent. interest? Ans. £120.

(*Women only*) (*a*) Prove that $\frac{3}{4}$ of $\frac{3}{5}$ of a unit = $\frac{9}{20}$ of the same unit.

(*b*) Explain as to a class of children, who can work easy direct sums in Simple Interest, the working of this sum : '*In what time will the Simple Interest on £650 amount to £130 at 5 per cent. per annum?*' Ans. 4 years.

15. (*Men only.*) The weight of the material of which a hollow spherical ball is composed is to that of a solid spherical ball of the same diameter (4 inches), and made of the same material, as 721 : 4096. Find the thickness (supposed uniform) of the material of the hollow ball. Take the weight of a solid sphere to vary as the cube of the radius. Ans. $\frac{1}{8}$ inch.

(*Women only.*) Make up a piece of calico in shape of apron, showing hemming, tucking, gathering, and trim with a whipped frill.

16. (*Men only.*) Write out Euclid I., 32.

Show how to construct an isosceles triangle whose vertical angle is four times each of the angles at the base.

(*Women only.*) How should you make (*a*) Beef-tea, and (*b*) Chicken broth for an invalid?

17. (*Men only.*) Write out Euclid VI. A.

Determine the locus of the vertex of a triangle on a given base, when the straight line drawn from the vertex to a fixed point in the base bisects the vertical angle.

(*Women only.*) Explain what is meant by '*National Insurance*,' with reasons for or against the project.

18. (*Men only.*) Prove that the sum of the squares of any number of unequal quantities is less than the square of their sum.

19. (*Men only.*) Prove that the sum of the roots of the equation $x^2 + px + q = 0$ is equal to $-p$ and the product $= q$.

(*Women only.*) As in First Year.

Fourth Week.

1. As in First Year.

2. As in First Year.

3. Give some familiar examples of false induction, and say what kind of school exercises are best calculated to encourage the habit of making a true use of the inductive process.

4. What is the exact meaning of 'organization' as applied to a school? Say how you would organize the work of a mixed school of 200 children, of whom 50 were under seven years of age. What staff would you require, and how would you distribute the work among its members?

5. Write the signatures of the following keys :—

(*a*) B♭ minor, (*b*) F♯ minor, (*c*) C♯ minor, (*d*) B♭ major, (*e*) F♯ major, and (*f*) C♯ major; OR

Ta is the name for *te* flat. What do the following names show?

(a) *re*, (b) *le*, (c) *la*, (d) *fe*, (e) *ra*, (*f*) *se*.

6. Write above the following an augmented sixth, a diminished third, and an augmented fifth :—A♭, E, E♭ ; OR

Rewrite the following on the imperfect method. Regard the first note in (*a*) as *doh*, and the first note in (*b*) as *me*.

(*a*) **s, l, f, m, r, f, t$_1$, d, r, m, fe, s, d', t.**

(*b*) **l, t, d', s, l, f, s, m, f, l, s, l, t, d'.**

7. (*Men only.*) As in First Year.

(*Women only.*) Give derivations of sapience, hierarchy, reluctation, aspersion, peremptory, and pasquin. How does Bacon use these words?

8. Analysis and Parsing from routine.

9. (*Men only.*) As in First Year.

(*Women only.*) Where, in the British Isles, are the chief centres of shipbuilding, coal-mining, linen, cotton, and woollen manufactures? What has caused the localization of these industries?

10. (*Men only.*) As in First Year.

(*Women only.*) Give an account of the climate, physical features, and productions of Queensland. Point out the characteristics of different parts of the colony. Compare or contrast Queensland with New Zealand.

11. (*Men only.*) As in First Year.

(*Women only.*) What was a '*Benevolence*,' and a '*Monopoly*'? When were these methods of raising money first employed, and when finally abolished?

12. (*Men only.*) As in First Year.

(*Women only.*) Who were the following: Anne Askew, Cardinal Pole, Miles Coverdale, Campeggio, David Rizzio, and Alva?

13. (*Men only.*) What is a concrete number?

Simplify $\frac{10\text{s. }3}{539\text{D}} + \frac{\cdot 712062 \text{ c. ft.}}{2156 \text{ c. in.}}$ Ans. 1.

(*Women only.*) As in First Year.

14. (*Men only.*) Find the exact compound interest on £1250 for 4 years at 3 per cent. Ans. £156 17s. 8d. ·643.

(*Women only.*) (*a*) The following sum was attempted by children who knew something about '*proportional parts*,' but they found it too hard: '*The sides of a triangle are proportioned to* 2½, 3, 3½, *their sum is* 338 *ft. Find each side.*' How would you work it on the blackboard? Ans. 88 ft., 120 ft., 130 ft.

(*b*) Define *prime number*, *complex fraction*, *average*, *present worth*, *stocks*. Give examples.

15. (*Men only.*) A sphere floats with ⅔ of its *surface* immersed. Find what fraction of its *volume* is submerged. Ans $\frac{27}{32}$.

(*Women only.*) Darn a cross-cut as for a table-cloth.

16. (*Men only.*) Write out Euclid I., 36.

On one side of an equilateral triangle construct a parallelogram equal to the sum of any parallelograms upon the two other sides.

(*Women only.*) Explain the terms :—*Interest*, *Consols*, *Mortgage*, *Insurance*, *County Court*.

17. (*Men only.*) Write out Euclid IV., 9.

Show that the square on the radius of a circle described about a square is double the square on the radius of the inscribed circle.

(*Women only.*) Mention any dangers incident to the use of (*a*) Gas, and (*b*) Paraffin lamps. Show how these dangers may be avoided.

18. (*Men only.*) Solve the equation $\sqrt[3]{x}+\sqrt[3]{x+1}=1$.

Ans. $x=\frac{(3+\sqrt{-15})^3}{4}$.

19. (*Men only.*) $x-y=m$; $nx+my=0$.

Ans. $x=m-n$; $y=-n$.

(*Women only.*) As in First Year.

CORRESPONDENCE.

We shall be pleased to reply briefly through these columns to any SUBSCRIBER *seeking examinational information or advice, and* ENCLOSING THE NECESSARY COUPON.

This privilege does not, of course, extend to furnishing the solutions and answers of problems. All such communications should be addressed to 'THE QUERY EDITOR.'

Replies demanding urgency will be promptly forwarded per post on the receipt of a stamped and addressed envelope, ACCOMPANIED BY THE REQUISITE COUPON.

A post will be saved by writing direct to DR. GEORGE BEACH, M.A., (*Examination Editor of* '*Practical Teacher*'), STANLEY MOUNT, MACCLESFIELD.

ANSWERED PER ORDINARY POST.

T. C. J. (Huddersfield) ; E. B. (Aberystwith) ; A. R. (Bilston) ; W. S. (Congleton) ; J. S. (Tipton) ; J. C. (Warwick) ; E. B. (Cauldon Lowe) ; W. W. (Barley) ; S. C. K. (Grays) ; B. G. (Congleton) ; W. C. (Washington) ; E. J. G. (Pentlepoir) ; W. J. D. (Douglas) ; L. P. (Gerton) ; 'Lucy' (Wakefield) ; J. L. (Marton) ; J. M. S. (Stretford) ; D. C. E. (Barnsbury) ; A. J. (Linthorpe) ; A. P. (Uxbridge) ; J. M. (Rochdale) ; A. M. F. (Birkenhead) ; T. J. (Treorky) ; W. C. (Manchester) ; J. W. (Pedygraig) ; F. E. (Rochdale) ; J. B. (Langley); S. K. S. (Dewsbury) ; H. L. G. (Grandborough) ; E. T. S. (Gosport) ; R. U. (Coventry).

S. S. (Thirsk).—Acting Teachers cannot now be examined in Science until next May.

W. L. (Shrewsbury).—(1) Get your correspondent to write direct to the department ; (2) Join the N. U. T.

J. W. (Hilton).—Try 'Picciola,' Hachette's, 1s. 6d., and also 'La Jeune Sibérienne,' Hughes.

L. B. (Cheltenham).—Received with thanks. Will comply next month.

N. I. B. (Dunham Hill).—The limitation as to Science Marks which we recently condemned has been altered, so that the Examinations may now be passed within TWO years of the Scholarship Examination.

A correspondent wishes to hear of a commentary upon, or notes on, 'Sartor Resartus.' We shall be glad if any of our readers who know of such a work will enlighten us.

MODEL ANSWERS TO SCHOLARSHIP QUESTIONS, 1893.

Candidates may not answer more than THREE of the sections under Question 1, and may answer ELEVEN other questions.

If you answer more than TWELVE questions, only the twelve answers coming first on your paper will be revised.

The solutions must be given at such length as to be intelligible to the Examiner, otherwise the answer will be considered of no value.

ARITHMETIC (MEN).

1. (*a*) Explain the method of forming the remainder in short division by a composite number.

Take as an example 4876 ÷ 105.

At what step in the division of money is the same principle illustrated?

(*a*) Consider Division as a kind of Reduction, so that if we divide 4876 *units* by 3 we get 1625 *threes* and 1 *unit* over. Again, dividing 1625 *threes* by 5 we obtain 325 *fifteens*, and carry on the one unit over. Lastly, dividing 325 *fifteens* by 7, the quotient is 46 *one-hundred-and-fives* and 3 *fifteens* over, besides carrying on the 1 *unit*. The answer thus is 46 with 3 fifteens + 1 unit over = 46 quotient and 46 remainder.

105 { 15 { 3 | units 4876
5 | threes 1625 — 1 unit
7 | fifteens 325 — 1 unit
one-hundred-and-fives 46 — 3 fifteens — 1 unit

Ans. $46\frac{46}{105}$.

There is nothing *exactly* similar to this process in Division of Money, but the question propounder seems to have thought that when the remaining pounds are reduced to shillings, and the odd shillings added in, etc., that this process was identical.

(*b*) Is it rational to divide or multiply one concrete number by another? Illustrate by these examples :

Find the number of half-crowns in £3 7s. 6d.

Find the price of 5 yds. 2 ft. 6 in. of silk at 4s. 6d. per yard.

On the principle of *cancelling* it is rational to divide one concrete number by another, and *practically* also the process is correct, for we can divide sixpences into threepences. Theoretically it is irrational, but the query is more one of logic than arithmetic.

Example (1) $\frac{\text{£3 7s. 6d.}}{\text{1 half-crown}} = \frac{\text{27 h-crowns}}{\text{1 h-crown}} = \underline{27}$. Ans.

Example (2) It must be carefully noted that the denomination of a number = *multiplication* by that denomination, *e.g.*, 5 yards = five *of* yards = 5 × 1 yard ; but *per* =

division, *e.g.*, 5s. per yard = 5s. ÷ by yards. This latter principle is shewn by the fact that 5s. *per* yard = 1s. 8d. *per* foot; or otherwise that 5s. per yard = 5s. ÷ yard = $\frac{5s.}{\text{yard}} \div 3 = 1s.\ 8d. \div$ ft.

Now $5\frac{5}{8}$ yards at 4s. 6d. per yard = $5\frac{5}{8}$ × yards × 4½s. ÷ yards

$= \frac{5\frac{5}{8} \text{ yards} \times 4\frac{1}{2}s.}{\text{yards}} = 5\frac{5}{8} \times 4\frac{1}{2}s. =$ £1 6s. 3d. Ans.

(*c*) What method do you employ for the division of decimals? How would you explain it to a class?

Take as examples 691·73 ÷ ·0013, and 69·173 ÷ 31·3.

The method of '*equalisation of places*.'

It is evident that thousands divided by thousands yield units, that hundreds divided by hundreds give units, and in general that one denomination by the same denomination gives units.

Thus $691{\cdot}73 \div {\cdot}0013 = 6917300 \div 13 =$ 532100. Ans.

Again, $\frac{69{\cdot}173}{31{\cdot}3} = \frac{69173}{31300} =$ 2·21. Ans.

Here $69{\cdot}173 \div 31{\cdot}3 = 69{\cdot}173 \times 1000 \div 31{\cdot}3 \times 1000$, etc.

After the ordinary division, by adding a nought to each of the successive remainders and continuing the division, we obtain as many decimal places in the quotient as there were noughts added.

(*d*) What is meant by the ratio of two numbers? Show how the unitary method may be abbreviated by the use of ratios. Illustrate this by this example:—If 5 cwt. 7 lbs. cost £3 12s., what is the price of 21 cwt. 1 qr. 14 lbs.?

The ratio of two numbers is their relative magnitude measured by the number of times which the one contains the other.

Cost of 5 cwt. 7 lbs. or 567 lbs. = £3 12s. 0d.
∴ Cost of 1 lb. = £3 12s. 0d. ÷ 567
∴ Cost of 21 cwt. 1 qr. 14 lbs.
or 2394 lbs. = £3 12s. 0d. × $\frac{2394}{567}$
= £3 12s. 0d. × $\frac{42}{9}$
= £0 8s. 0d. × 38
= £15 4s. 0d. Ans.

2. Find, by practice, the value of 15 tons 19 cwt. 3 qrs. 16 lbs. at £26 5s. per ton.

(*a*) £26 5s. 0d. = Cost of 1 ton.
16
£420 0s. 0d. = Cost of 16 tons.

8 lbs. of 1 ton = $\frac{1}{280}$ | £26 5s. 0d. = Cost of 1 ton.
4 lbs. of 8 lbs. = $\frac{1}{2}$ | 1s. 10½d. = Cost of 8 lbs.
11½d. = Cost of 4 lbs.

(*b*) 2s. 9¾d. = Cost of 12 lbs.

£420 0s. 0d. = Cost of 16 tons.
(*c*) 2s. 9¾d. = Cost of 12 lbs.
Ans. ∴ £419 17s. 2¼d. = Cost of 15 tons 19 cwt. 3 qrs. 16 lbs.

3. Determine the order of magnitude of the fractions $\frac{104}{185}$, $\frac{122}{233}$, $\frac{154}{273}$.

The *neatest* method is:—
The order of magnitude of $\frac{104}{185}$, $\frac{122}{233}$, $\frac{154}{273}$ is the same as
The order of magnitude of $\frac{104}{81}$, $\frac{122}{111}$, $\frac{154}{141}$, is the same as
The order of magnitude of $\frac{23}{81}$, $\frac{11}{111}$, $\frac{13}{141}$.
Here it is plain that the three fractions are already in order of ascending magnitude.

4. A man buys a flock of 117 sheep for £248 12s. 6d.; he loses 4 and finds 24 others so sickly that he must sell them at once for 10s. a piece less than he gave for them; at what price per head must he sell the rest to gain £24 by the transaction?

117 sheep cost £248 12s. 6d.

(*a*) ∴ 1 ,, ,, £2 2s. 6d.

(*b*) Selling price of 24 sheep = 24 (£2 2s. 6d. minus 10s.) = £1 12s. 6d. × 24 = £39.

(*c*) No. sheep remaining = 117 − 4 − 24 = 89.

(*d*) Price of 89 sheep must = £248 12s. 6d. + £24 profit − £39 received for 24 sheep = £233 12s. 6d.
∴ Price of 1 sheep must = £2 12s. 6d. Ans.

5. Reduce $(4\frac{3}{8} + 9\frac{1}{15} - 10\frac{4}{5} - \frac{42}{117})$ of 5s. 7½d. to the fraction of $\frac{\frac{3}{5} - \frac{3}{7}}{\frac{4}{9} - \frac{5}{11}}$ of 9s. 4d.

$$\frac{\left(\frac{11}{3} + \frac{1}{15} - \frac{4}{5} - \frac{4}{9}\right) \times 135 \text{ halfpence}}{\left(\frac{35}{56} - \frac{24}{56}\right) \div \left(\frac{56}{126} - \frac{45}{126}\right) \times 224 \text{ halfpence}}$$

$$= \frac{165 + 3 - 36 - 20}{\frac{45}{\frac{11}{56} \times \frac{126}{11} \times \frac{224}{1}}} \times 135$$

$$= \frac{112 \times 3 \times 56 \times 11 \times 1}{1 \times 11 \times 126 \times 224}$$

$$= \frac{3 \times 56}{126 \times 2} = \frac{28}{42} = \frac{2}{3}. \quad \text{Ans.}$$

6. Multiply $6{\cdot}\dot{3}\dot{6}$ by $\cdot\dot{5}7142\dot{8}$, and give the answer in decimals.

$6{\cdot}\dot{3}\dot{6} \times {\cdot}\dot{5}7142\dot{8} = \frac{70}{11} \times \frac{4}{7} = \frac{40}{11} = 3\frac{7}{11} =$ 3·6̇3̇. Ans.

7. First, second, and third class fares are 2¾d., 1¾d., and 1d. per mile respectively, and there are 5 first class passengers to every 3 second and to every 47 third class. What sum did each class of passengers who travelled from A to B contribute to a total receipt of £53,974 16s. for fares between A and B?

(*a*)

		s.	d.
5 First Class	@ 2¾d. =	1	1¾
3 Second ,,	@ 1¾d. =	0	5¼
47 Third ,,	@ 1d. =	3	11
	Total	5	6

(*b*) The problem may now be thus stated—'If first class contributes 1s. 1¾d. out of 5s. 6d., what will it contribute out of £53,974 16s.', etc.

As 5s. 6d. : £53,974 16s. :: 1s. 1¾d. : Ans.; *or*,
As 264 : 55 :: £53,974 16s.
As 24 : 5 ::
As 1 : 5 :: £2,248 19 0
5
£11,244 15 0 Ans.

Similarly with second class £4,293 9s. 0d. Ans.
,, third ,, £38,436 12s. 0d. Ans.

8. An employer pays each of his workmen 27*s.* per week when they work 9 hours a day: what should he pay them when they work only 8 hours a day, if in that case 12 men do as much in an hour as 13 in the former case?

As $\left.\begin{matrix}9\\12\end{matrix}\right\}$: $\left.\begin{matrix}\\\end{matrix}\right\}$ 8 :: 27s. : Ans.
13

s. $\frac{27 \times 8 \times 13}{12 \times 9} =$ 26s. Ans.

9. Find the side of a square equal in area to a rectangle whose sides are 24·7 feet and 7138·3 feet.

Area of rectangle = L × B = 24·7 ft. × 7138·3 ft.
∴ ,, square = 24·7 × 7138·3 s. ft. = 24·7 × 24·7 × 289
∴ Side of ,, = √24·7 × 24·7 × 289.
= 24·7 × 17 = 419·9 ft. Ans.

10. If the duty on an article be reduced 40 per cent. on its present amount, by how much per cent. must the consumption be increased (1) in order that the revenue may not suffer, (2) that it may gain 10 per cent.?

(*a*) The duty being only $\frac{60}{100}$ of the former duty, the consumption must be $\frac{100}{60}$, or 166⅔ p.c. of former consumption.
∴ Increase = 66⅔ p.c. Ans.

(*b*) To gain 10 p.c. the consumption must be $\frac{1}{10}$ more than in former part of question, viz., 166⅔ p.c. + 16⅔ p.c.
= 183⅓ p.c. ∴ Increase = 83⅓ p.c. Ans.

11. Find the difference between the simple interest and the discount on £1,501 13s. 4d., due 2½ years hence at 2½ per cent.

Simple Interest = £1501 13s. 4d. × $\frac{25}{4} \times \frac{1}{100}$
= £1501 13s. 4d. × $\frac{1}{16}$ = £93 17s. 1d.

Discount = £1501 13s. 4d. × $\frac{\text{£6 5s. 0d.}}{\text{£106 5s. 0d.}}$
= £1501 13s. 4d. × $\frac{1}{17}$
= £88 6s. 8d.;

∴ Difference = £93 17s. 1d. minus £88 6s. 8d.
= £5 10s. 5d. Ans.

12. A man makes a profit of $2\frac{1}{2}$ per cent. by selling an article for £1 1s. $4\frac{1}{2}$d. ; how much per cent. would he make by selling it for £1 1s. 3d. ?

As £1 1s. $4\frac{1}{2}$d. : £1 1s. 3d. :: $102\frac{1}{2}$ per cent. : Ans.

$$1025 : 1020 :: \frac{205}{2}$$

$$\text{p.c. } \frac{205 \times 1020}{2 \times 1025} = 102 \text{ p.c.}$$

Profit = 2 per cent. Ans.

13. The gross rental of an estate was £1,699 1s. 3d., but the owner returned 24 per cent. of it to the tenants, then spent £66 14s. 1d. on repairs, and the agent received 7 per cent. of the remainder. How much was left for the owner ?

24 p.c. of £1699 1s. 3d. = £407 15s. 6d. } = £474 9s. 7d.
Repairs = £66 14s. 1d. }
∴ Remainder = £1699 1s. 3d. minus £474 9s. 7d.
= £1224 11s. 8d.
But owner received $\frac{93}{100}$ of £1224 11s. 8d. = £12 4s. 11d.
× 93 = £1138 17s. 3d. Ans.

14. A person invests half his capital in 3 per cent. debentures at $101\frac{1}{2}$, and the other half in 4 per cent. debentures at 135 ; his total income from both sources is £202 15s. How much did he invest ? (Neglect brokerage.)

Income from 3 per cents. $= \frac{6}{203} = \frac{810}{203 \times 135}$ of half capital.
,, ,, debentures $= \frac{4}{135} = \frac{812}{135 \times 203}$,, ,,
∴ Ratio of income from the two investments = As 810 : 812, or as 405 : 406.
∴ Income from debentures = $\frac{406}{811}$ of £202 15s. = £101 10s.
Now cash to produce £4 in debentures = £135.
∴ ,, ,, £$101\frac{1}{2}$,, = £$\frac{135 \times 101\frac{1}{2}}{4}$
= £3425 12s. 6d.
∴ Sum invested = £3425 12s. 6d. × 2 = £6851 5s. Ans.

WOMEN.

Answer three of the four parts (*a*, *b*, *c*, *d*) of Question 1, and not more than *eleven* other questions. If you answer more than 12 questions, only the twelve answers coming first on your paper will be revised.

The solutions must be given at such length as to be intelligible to the examiner, otherwise the answer will be considered of no value.

1. (*a*) How would you explain long division to a class of children who have worked sums in short division ? (*e.g.* 403 ÷ 19.)

Show first that long division differs from short in *form* only, and not in principle or process, and that

$9 \overline{)\,403\,} \; 44\frac{7}{9}$ might be extended to

9)403(44$\frac{7}{9}$
36
43
36
7

I should not begin with such a Divisor as 19, which is nearly 20, but such as 9I.

To divide 403 *by* 19.

19 into 4 hundreds will not go ; try 19 into 40 tens. Now 20 into 40 tens will go 2 tens, ∴ probably 19 into 40 tens will go 2 tens. This is found to be the case, 19 times 2 tens being 38 tens and 2 tens remaining. These 2 tens are now regarded as 20 units, which with the 3 units will make 23 units. It is plain that 19 into 23 units will go 1 unit and 4 remaining. Set down as shown.

19)403(21$\frac{4}{19}$
38
23
19
4

(*b*) By what method would you enable children to ascertain whether a given number is a prime ? (*e.g.* 163.)

(*b*) α Extract the sq. root of 163 ; this is found to be less than 13, ∴ of two hypothetical factors of 163 one at least must be less than 13, *i.e.* either 12, 11, 10 or 9, etc.

β But 163 is odd, ∴ 2, 4, 6, 8, 10, 12 cannot be factors.

γ Again, 1 + 6 + 3 is not divisible by 3, therefore 3 and 9 cannot be factors.

δ Again, 163 does not end with 0 or 5, therefore 5 cannot be a factor.

ε By trial 7 is not a factor.

ζ Again, {6 — (1 + 3)} is not divisible by 11, therefore 11 is not a factor, ∴ 163 is prime.

(*c*) How would you explain to beginners in fractions that the value of a fraction is not altered by multiplying the numerator and denominator by the same number ?

(*c*) Fractions may be regarded as concrete numbers. Thus $\frac{2}{3}$ may be thought of as 2 thirds. Now if we multiply the number of things (say) by four, and at the same time make their denomination only one-fourth the value, the total value is unaltered.

Thus 2 shillings $= 2 \times 4 \frac{\text{shillings}}{4} = 8$ threepences.

So 2 thirds $= 2 \times 4 \frac{\text{thirds}}{4} = 8$ twelfths $= \frac{8}{12}$

Again, fractions may be regarded as ratios, so that $\frac{2}{3}$ may represent 2 out of every three ; this is obviously the same as 8 out of every 12.

There are other methods, but these accompanied by diagrams would serve.

(*d*) Define proportion, and give a simple method for showing that the product of the extremes is equal to the product of the means.

(*d*) Proportion consists in the equality of ratios.
Thus if $\frac{2}{3} = \frac{8}{12}$, then as 2 : 3 :: 8 : 12.
Now by theory of fractions (see (*c*) supra) whatever *multiple* 12 is of 3, 2 is the same *measure* of 8, so that if 2 be multiplied by 12 and 3 be multiplied by 8 the products must be equal.

Thus $\frac{2}{3} = \frac{8}{12} = \frac{2 \times 4}{3 \times 4} = \frac{2}{3}$, and $\frac{2}{3}$ multiplied by its reciprocal $\frac{3}{2}$ must produce unity.

2. What is the rent of a farm of 179 acres 3 roods 16 poles at £1 3s. 4d. per acre ?

(*a*) £1 3s. 4d. = cost of 1 acre.
180
£210 0s. 0d. = cost of 180 acres.

16 poles of 1 acre = $\frac{1}{10}$ | £1 3s. 4d. = cost of 1 acre.
(*b*) 8 poles of 16 poles = $\frac{1}{2}$ | 2s. 4d. = cost of 16 poles.
1s. 2d. = cost of 8 poles.
3s. 6d. = cost of 24 poles.

(*c*) Cost of 180 acres = £210 0s. 0d.
Cost of 24 poles = 3s. 6d.
∴ Cost of 179 acres, 3 roods, 16 poles = £209 16s. 6d. Ans.

3. What is the greatest length of which 18 yds. 1 ft. 3 in. and 20 yds. 1 ft. 9 in., are multiples ?

18 yds. 1 ft. 3 ins. = 663 ins.
20 yds. 1 ft. 9 ins. = 741 ins.
G.C.M. of 663 ins. and 741 ins. = 39 ins. = 3 ft. 3 ins. Ans.

4. Reduce $\frac{3}{4}$ of £7 5s. 3d. + $\frac{4}{11}$ of £17 15s. 10½d. + $\frac{5}{17}$ of £1 6s. 11d. to the fraction of £26 19s.

(*a*) $\frac{3}{4}$ of £7 5s. 3d. = £3 2s. 3d.
$\frac{4}{11}$ of £17 15s. 10½d. = £5 9s. 6d.
$\frac{5}{17}$ of £1 6s. 11d. = 7s. 11d.
Total £8 19s. 8d.

(*b*) $\frac{\text{£8 19s. 8d.}}{\text{£26 19s. 0d.}} = \frac{1}{3}$. Ans.

5. If the carriage of 3 tons 15 cwt. for a distance of 200 miles cost £11 13s. 4d., how much should be charged for the carriage of $7\frac{1}{2}$ cwt. for 125 miles ?

As 3 tons 15 cwt. } : 7½ cwt. } :: £11 13s. 4d. : Ans.
200 } : 125 } 2,800d.

$$\frac{2800\text{d.} \times 15 \times 125}{200 \times 150} = \frac{14 \times 25}{2}\text{d.} = 175\text{d.} = 14\text{s. } 7\text{d. Ans.}$$

6. A bill of £41 2s. 3d. was paid with an equal number of pounds, shillings, and pence ; how many were there of each ?

£1 1s. 1d. = 253d.
£41 2s. 3d. = 9867d.
9867d. / 253d. = 39.

∴ If a bill of 253d. can be paid by £1, 1s., and 1d., a bill of £41 2s. 3d. can be paid by £39, 39s., and 39d. Ans.

7. Simplify (*a*) $3{\cdot}52 \div {\cdot}005 \times 1{\cdot}03 \div {\cdot}044$; and (*b*) find the value (in yds. ft. in.) of ·0109375 of a mile.

(*a*) $\frac{3{\cdot}52}{{\cdot}005} \times \frac{1{\cdot}03}{{\cdot}044} = \frac{3520}{5} \times \frac{1030}{44} = 80 \times 206 = \underline{16480}$. Ans.

(*b*) mile ·0109375
1760
yds. 19·25
3
ft. 0·75
12
ins. 9·00

Ans. 19 yds. 9 ins.

8. Find the rate per cent. per annum at which £314 12s. 6d. will amount to £346 1s. 9d. in $2\frac{3}{8}$ years at simple interest.

Amount = £346 1 9
Principal = £314 12 6
Interest = £31 9 3

The problem is now Compound Proportion: If £314 12s. 6d. produce £31 9s. 3d. in $\frac{8}{3}$ yrs., what will £100 produce in 1 year?

As $\begin{matrix} 8 \\ 2517 \end{matrix}$: $\begin{matrix} 3 \\ 800 \end{matrix}$ :: £31 9s. 3d. : Ans.

£31 9s. 3d. $\times \frac{100}{839} = \frac{£3146\ 5s.\ 0d.}{839} = \underline{£3\ 15s.,\ \text{or}\ 3\frac{3}{4}\ \text{p.c.}}$ Ans.

9. A man makes a profit of $2\frac{1}{2}$ per cent. by selling an article for £1 1s. $4\frac{1}{2}$d.; how much per cent. would he make by selling it for £1 1s. 3d.?

See sum 12 (*Men*). Ans. 2 per cent.

10. If the present worth of £232 17s. 6d., due in a year at $3\frac{1}{2}$ per cent., be invested in a $3\frac{1}{2}$ per cent. stock at $112\frac{1}{2}$, what income will be derived? (Neglect brokerage.)

As $103\frac{1}{2}$: 100 :: £232 17s. 6d. : Ans.

(*a*) 207 : 200 :: £232 17s. 6d. : Ans.
1 : 200 :: £1 2s. 6d. : Ans.
£225.

(*b*) Income from $£112\frac{1}{2} = £3\frac{1}{2}$.
∴ ,, ,, £225 = £7. Ans.

11. A man embarks his whole capital in four successive ventures; in each of the first two he gained 75 per cent., in each of the last two he lost $33\frac{1}{3}$ per cent. Find the ratio of his final to his original capital.

In first venture £100 becomes £175.

,, second ,, £175 ,, $£175 \times \frac{175}{100}$.

,, third ,, $£175 \times \frac{175}{100}$ becomes $£175 \times \frac{175}{100} \times \frac{2}{3}$.

,, fourth ,, $\frac{£175 \times 175 \times 2}{100 \times 3}$ becomes $\frac{£175 \times 175 \times 2 \times 2}{100 \times 3 \times 3}$

$= £\frac{7 \times 175}{9} = £\frac{1225}{9} = £136\frac{1}{9}$.

Ans. As $136\frac{1}{9}$: 100 *or* As 1,225 : 900.

12. A, B, C invested £9,410, £3,674, and £5,216 respectively in a business, in which the net profits for a year were £1,448 15s.; how should the net profits be divided?

Capital of A = £9,410
,, ,, B = £3,674
,, ,, C = £5,216
Total = £18,300

As £18,300 : 9,410 :: £1,448 15s. : A's profits.
1,830 : 941 :: £1,448 15s.
30 : 941 :: £ 23 15s.
6 : 941 :: £ 4 15s.
1 : 941 :: £ 0 15s. 10d.
Ans. £744 19s. 2d. = A's profits.
Similarly ,, £290 17s. 2d. = B's ,,
Similarly ,, £412 18s. 8d. = C's ,,

13. A cistern can be filled by one pipe A in $30\frac{1}{3}$ minutes, by another B in $38\frac{1}{2}$ minutes, and it can be emptied by a third pipe C in $17\frac{7}{8}$ minutes. If it be empty and they are all opened together in what time will the cistern be filled?

A in one minute can fill $\frac{1}{30\frac{1}{3}} = \frac{3}{91}$ of the cistern.

B ,, ,, ,, $\frac{1}{38\frac{1}{2}} = \frac{2}{77}$,, ,,

C ,, ,, can empty $\frac{1}{17\frac{7}{8}} = \frac{8}{143}$,, ,,

∴ A + B − C in one minute can fill $\frac{3}{91} + \frac{2}{77} - \frac{8}{143}$

$= \frac{33 + 26 - 56}{1001} = \frac{3}{1001}$

∴ Time to fill the cistern $= \frac{1001}{3}$ mins. $= 333\frac{1}{3}$ mins.
$= \underline{5\ \text{hrs.}\ 33\frac{1}{3}\ \text{mins.}}$ Ans.

14. How far may I travel in a coach which goes at the rate of 8 miles per hour, starting at 10 A.M., in order to return on foot to the starting place at the rate of $3\frac{1}{3}$ miles per hour by 32 min. past 2 p.m.?

Time for both journeys = 4 hrs. 32 mins.

As time for outward journey : time for return journey :: rate for return journey : rate for outward journey.

And as time for outward journey : 4 hrs. 32 mins. :: $3\frac{1}{3}$: $11\frac{1}{3}$, or total rate.

Time for outward journey = $\frac{3\frac{1}{3}}{11\frac{1}{3}}$ of 4 hrs. 32 mins.

$= \frac{10}{34} \times 272$ mins. = 80 mins.

∴ Distance travelled in 80 mins. at 8 miles per hour
$= \underline{10\frac{2}{3}\ \text{miles}}$. Ans.

EUCLID (MEN ONLY).

Friday, July 7th, 10 to 1.

(*Marks are given for portions of questions.*)

All generally understood abbreviations for words may be used, but symbols of operation (such as —, +, ×), are not admissible.

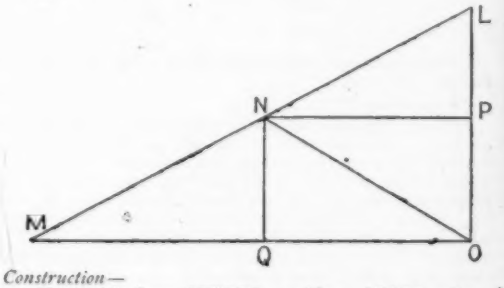
Capital letters, not numbers, must be used in the diagrams.

1. (*a*) Define straight line, plane, angle, figure, semicircle, rhombus, axiom.

See any respectable Euclid.

(*b*) Construct a triangle, having given two sides and an angle opposite to one of them; and show that there may be two solutions, one, or none.

Let LM and LN be the given sides, and ∠LMN the given angle.



Construction—

From M draw MNOPQ, making ∠LMN = the given angle.

From L, with radius LN, describe a circle. This will either

(1) *Cut* MQ in *two* points, N and P, *or*
(2) *Touch* MQ in *one* point, O, *or*
(3) *Fall short* of MQ, as in R.

Proof—

Manifest.—Q.E.D.

2. (*a*) If at a point in a straight line two other straight lines on the opposite sides of it make the adjacent angles together equal to two right angles, these two straight lines shall be in one and the same straight line.

Euclid I., 14.

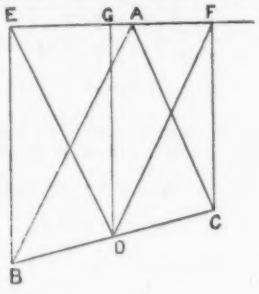
ERRATA.

Model Answers to Scholarship Questions.

Euclid, pp. 92 and 93.

Owing to an error several of the blocks have been wrongly inserted in the above. The following figures should be interchanged:—figures 1 and 5; figures 2 and 6. Figure 3 should appear under 4 (b).

(*b*) ABC is a triangle in which AB is greater than AC. The bisector of the angle A meets the base in D. Show that the angle ADB is an obtuse angle. (This may be shown by using I., 4 and 13.)

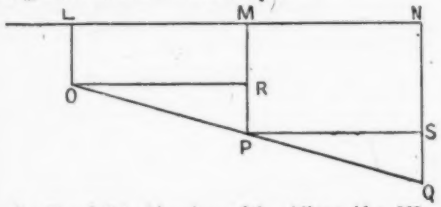


Construction—
Make AE = AC, and join DE.
Then ∧ADE = ∧ADC (I. 4).
Again, ∧ADB + ∧ADC = 2 right angles;
∴ ∧ADB + ∧ADE = 2 right angles.
But ∧ADB is greater than ∧ADE (Ax. 9);
∴ ∧ADB is greater than 1 right angle.—Q.E.D.

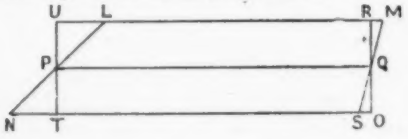
3. (*a*) The opposite sides and angles of parallelograms are equal to one another, and the diameter bisects them, that is, divides them into two equal parts.
Euclid I., 34.

(*b*) The line which joins the middle points of the oblique sides of a quadrilateral whose other sides are parallel to one another, is equal to the semi-sum of the two parallel sides. (Draw lines through the middle points of the oblique sides perpendicular to the parallel sides, &c.)

Let MSNL be a quadrilateral whose sides ML and NS are ||, but sides NL and SM oblique.



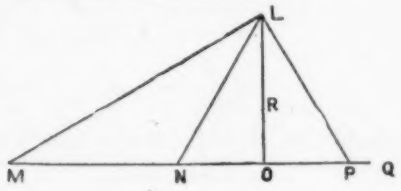
Let P and Q be bisections of the oblique sides, NL and SM, and let PQ be joined, and UPT and RQO be drawn respectively through P and Q perp. both to LM and NS.
Then PQ = half the sum of LM and NS.



Proof—
UTOR is a parallelogram (I., 28);
∴ UR = PQ = TO (I. 33).
But UL = NT, and SO = RM (I. 26);
And PQ = half the sum of UR and TO
= half the sum of UR and TO less UL and less OS, and augmented by NT and RM
= half the sum of LM and NS.—Q.E.D.

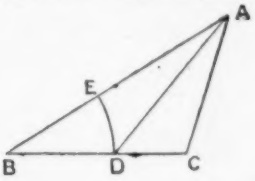
4. (*a*) Prove that in a right-angled triangle, the middle point of the hypotenuse is equally distant from the three angles. (Draw perpendiculars from the middle point to the sides, &c.)

Let LOM be any triangle right-angled at O, let N be the middle point of hypotenuse LM, and NQ and NP perpendiculars upon MO and LO respectively.
Join NO. Then MN = NO = NL.



Proof—
QP is a parallelogram (I. 28); ∴ NQ = PO, and NP = QO.
Again, △ MNQ = △ NLP, and NQ = LP (I. 26); ∴ PO = LP.
Again, △ NLP = △ NOP, and NL = NO (I. 4).
But MN = NL; ∴ MN = NL = NO.—Q.E.D.

(*b*) In any triangle ABC, if BE, CF be perpendiculars on any line through A, and D be the bisection of BC, show that DE = DF. (Produce ED, and make use of I. 28, 26, and of (*a*).)



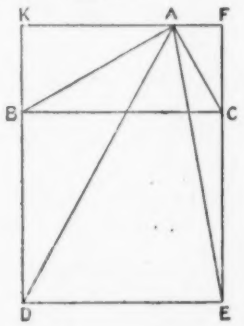
Construction—
Draw DG perp. to EAF.

Proof—
From diagram (*b*).
Let OQ be any line and P its middle point.
Let LN be any other line not parallel to OPQ.
Let OL, PM, and QN be perps. to LN.
Then LM = MN.
Draw OR, PS parallel to LN.
Then LR and MS are parallelograms (I. 28), and OR = LM, and PS = MN.
(By I. 26) △ ORP = △ PSQ and OR = PS;
∴ LM = MN.
In diagram (*a*) EG = GF (from diagram *b*).
Then △ DGE = △ DGF, and DE = DF (I. 4).—Q.E.D.

5. (*a*) If a straight line be divided into any two parts, the squares on the whole line, and on one of the parts, are equal to twice the rectangle contained by the whole and that part, together with the square on the other part.
Euclid II. 4.

(*b*) If from the right angle of a right-angled triangle lines be drawn to the opposite angles of the square described on the hypotenuse, the difference of the squares on these lines is equal to the difference of the squares on the two sides of the triangle. (II. 12 may be used.)

Let ABC be the △ right-angled at A. Let BE be square on BC.
Join AD and AE.
Then $AD^2 - AE^2 = AB^2 - AC^2$.



Construction—
Draw KAF through A parallel to BC.
Produce DB and EC to meet KAF in K and F respectively.

Proof—
$AD^2 = AB^2 + BD^2 + 2DB, BK$.
$AE^2 = AC^2 + CE^2 + 2EC, CF$,
but $BD^2 = CE^2$,
and $2DB, BK = 2EC, CF$.
∴ $AD^2 - AE^2 = AB^2 - AC^2$.—Q.E.D.

ALGEBRA.

6. (*a*) Resolve $(a+b+c)^2 - (a-b-c)^2$ into factors, and (*b*) divide $m^3 + n^3 - 8r^3 + 3m^2n + 3mn^2$ by $m + n - 2r$.

(*a*) $(a+b+c)^2 - (a-b-c)^2$
$= (a+b+c+a-b-c)\,(a+b+c-a+b+c)$
$= 2a \times 2(b+c) = \underline{4a(b+c)}$. Ans.

(*b*) $(m^3+n^3-8r^3+3m^2n+3mn^2)\div(m+n-2r)$
$=\{(m+n)^3-(2r)^3\}\div\{(m+n)-2r\}$
$=(m+n)^2+2mr+2nr+(2r)^2$
$=\underline{m^2+2mn+n^2+2mr+2nr+4r^2}$. Ans.

7. (*a*) Prove the rule for the multiplication of two algebraical fractions.

See any Algebra.

(*b*) Simplify $\dfrac{a^2+b^2}{a^2-b^2}-\dfrac{1}{\dfrac{2a}{2a-b}-\dfrac{2b}{2b-a}}$.

$$\frac{a^2+b^2}{a^2-b^2}-\frac{1}{\frac{2a}{2a-b}+\frac{2b}{a-2b}}$$
$$=\frac{a^2+b^2}{(a+b)(a-b)}-\frac{2a^2-5ab+2b^2}{2a^2-4ab+4ab-2b^2}$$
$$=\frac{a^2+b^2}{(a+b)(a-b)}-\frac{2a^2-5ab+2b^2}{2(a+b)(a-b)}$$
$$=\frac{2a^2+2b^2-2a^2+5ab-2b^2}{2(a+b)(a-b)}$$
$$=\underline{\frac{5ab}{2(a+b)(a-b)}}.$$ Ans.

8. (*a*) Write down the sum of the roots of the equation $ax^2+bx+c=0$.

$$x^2+\frac{b}{a}x+\frac{c}{a}=0$$

The sum of the roots always=the coefficient of x with the sign changed; $\therefore =-\dfrac{b}{a}$.

(*b*) Solve the equations.

(i) $\dfrac{4x}{5}-3\left(\dfrac{2x-1}{2x+1}\right)=\dfrac{n}{3}-\dfrac{1-8x}{10}$.

$16x^2+8x-60x+30=60x+30+16x^2+6x-1$
$-118x=-1$
$\underline{x=\tfrac{1}{118}}$. Ans.

(ii) $\begin{cases}\dfrac{5x}{3}-44=\dfrac{3y}{4}\\ \dfrac{2x}{13}+\dfrac{4y}{7}=22\end{cases}$

(I.) (II.)
(*c*) $\dfrac{5x}{3}-44=\dfrac{3y}{4}$; $\dfrac{2x}{13}+\dfrac{4y}{7}=22$.

(III.) (IV.)
I. × 12 $20x-9y=528$; $14x+52y=2002$ II. × 91

(V.) (VI.)
III. × 7 $140x-63y=3696$; $140x+520y=2002c$ IV. × 10

(VII.)
$583y=16324$ VI.–V.
$y=28$

(VIII.)
$14x+1456=2002$ IV. and Substitution
$14x=546$
$x=39$

Ans. $\underline{x=39;\ y=28}$.

(iii) $\dfrac{x-3}{x-4}+\dfrac{x-1}{2-x}=\dfrac{1}{12}$.

$$\frac{x-3}{x-4}-\frac{x-1}{x-2}=\frac{1}{12}$$
$12x^2-60x+72-12x^2+60x-48=x^2-6x+8$
$0=x^2-6x-16$
$0=(x-8)(x+2)$
$\therefore x=8$ or -2. Ans.

9. Answer (*b*); but if you cannot do so, answer (*a*). Do not answer both (*a*) and (*b*).

(*a*) The difference between the numerator and denominator of a fraction is 8, and if each be increased by 17 the fraction becomes equal to $\frac{3}{4}$. Find it.

Let a = numerator of given fraction,

Then $\dfrac{a}{a+8}$ = fraction

$\dfrac{a+17}{a+25}=\dfrac{3}{4}$
$\therefore 4a+68=3a+75$
$a=7$
$a+8=15$

Ans. $\frac{7}{15}$.

(*b*) The price of oranges is raised 6d. per dozen, and customers consequently receive 128 less than before for £1. What was the first price per dozen?

Let x in pence = first price per dozen.
Then $x+6$ = second price per dozen.
No. first bought for £1 $=\dfrac{240\times12}{x}$.
No. next bought for £1 $=\dfrac{240\times12}{x+6}$.

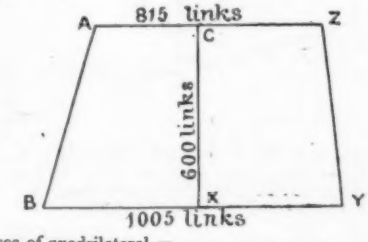
$\therefore \dfrac{240\times12}{x}-128=\dfrac{240+12}{x+6}$
$\dfrac{2880-128x}{x}=\dfrac{2880}{x+6}$
$-128x^2+2112x+17280=2880x$
$128x^2+768x-17280=0$
$x^2+6x-135=0$
$(x+15)(x-9)=0$
$\therefore x=9$ or -15.

The minus value being inadmissible
$\underline{x=9}$ is Answer; or 9d. per dozen.

MENSURATION.

(*Answer one question only.*)

10. A quadrilateral field has two sides parallel to one another, whose lengths are 8 chains 15 links, and 10 chains 5 links, and the perpendicular distance between them is 6 chains. Find the area, and the rent of the field at £2 5s. per acre.



Area of quadrilateral =
$(815+1005)\ 300=546{,}000$ square links
$=5{\cdot}46$ acres
Cost of 5·46 acres at £2·25 per acre $=$ £5·46 × 2·25
$=$ £12·285 $=$ £12 5·7s. $=\underline{\text{£12 5s. 8·4d.}}$ Ans.

11. The area of the space between two concentric circles is 1,078 square feet; the radius of the larger circle is 28 feet. Find the radius of the inner circle. ($\pi=\frac{22}{7}$).

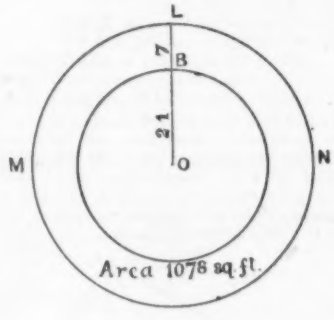


Fig. 9

Area of outer circle $=(28)^2\times\frac{22}{7}=2{,}464$ square feet
$\therefore$,, inner ,, $=(2464-1078)$ square feet
$=1{,}386$ square feet.

$\therefore$ Radius of inner circle $= \sqrt{(1386 \times \frac{7}{22})}$ feet
$= \sqrt{441}$ feet
$= 21$ feet. Ans.

GRAMMAR AND COMPOSITION.—MEN AND WOMEN CANDIDATES.

Wednesday, July 5th, 2.30 to 5.

All candidates *must* answer questions 1 and 2, and may select *four*, but not more, of the remaining eight questions.

If you answer more than *six* questions, only the *six* answers coming first on your paper will be revised.

No abbreviation of less than three letters is to be used in parsing or analysis.

1. Write a short essay on one of these subjects :—
   (*a*) Holidays, and the way to use them.
   (*b*) Parliament.
   (*c*) Tragedy and comedy.

Essay on Parliament.

When we speak of Parliament in England we mean the legislative power of the country exercised by its duly elected representatives in lawfully convoked assembly (who form the House of Commons), and by the Peers of the land, who form the House of Lords. Looking back into history, we find that the earlier kings were almost despotic, levying taxes from the people of their own accord. When these things were carried to excess, as in King John's case, we see how his subjects rose unanimously against him and compelled him to sign the 'great charter' of English liberties (1215). The first really representative English Parliament was formed in Henry III.'s reign (1265), two citizens appearing for each city, and two knights for each shire. Power from this time gradually passed from King to Parliament, and especially so in the reigns of weak kings; *e.g.* Ordainers governed the country in Edward II.'s reign, and Charles I. was beheaded by the Long Parliament (1649). Measures passed at various times increasing the people's liberty were Petition of Rights (1627), Habeas Corpus Act (1679), and Bill of Rights (1689). The Commons only, without the assistance of the Lords, regulate pecuniary affairs now, therefore the people tax themselves (through their members). Thus we see how Parliament has gained liberty for the people, for, under the British Constitution, we are enabled to live peacefully and contentedly and have the rights of free citizens. The chief characteristic of the British Parliament is its stability.

2. How many separate sentences are there in the following extract? How are they related to each other, and what are the chief parts of each?

Fair laughs the morn, and soft the zephyr blows,
While, proudly riding o'er the azure realm
In gallant trim, the gilded vessel goes,
Youth on the prow, and Pleasure at the helm,
Regardless of the sweeping whirlwind's sway,
That, hushed in grim repose, expects his evening prey.

Sent.	Kind of Sent.	Subj.		Pred.		Obj.		Conn.
		Simp.	Extens.	Simp.	Extens.	Simp.	Extens.	
A. Fair . morn.	Prin. Sent.	morn	the	laughs	fair (man.)			
B. soft . blows.	Prin. Sent. Co-ord with *A.*	zephyr	the	blows	soft (man.)			and
(*C*) while . . . . . prey	Subord Adv. Sent. to *A* and *B*, mod. *laughter* and *blows*	vessel	(1) the gilded (2) proudly . . . realm (3) youth . . . . helm (4) regardless . . . prey	goes	(1) in . . trim			while
D. That . . . . . prey	Subord. Adj. Sent. to *C*, qual. *vessel*	that	hushed . . repose	expects		prey	his evening	

3. Paraphrase the following passage :—

I do remember *me*, that in my youth,
When I was wandering, upon such a night
I stood within the Coliseum's wall,
Midst the chief relics of almighty Rome ;
And thou didst shine, thou rolling *moon*, upon
All this, and *cast* a wide and tender light
Which softened *down* the hoar austerity
Of rugged desolation, and filled up
As 't were anew, the gaps of centuries :
Leaving that beautiful which still was so,
And making that which was not.

I clearly recollect that it was on a night just like this, whilst I was travelling about when I was a young man, that I stood inside the Coliseum, surrounded by all the most important remains of Rome's ancient greatness. The revolving moon cast its rays upon all these noble things, and spread over all such a softened light, that it dispersed all stern thoughts of the aged and jagged ruins, and made one recall to mind, as if they were only just happening, the chief events of bygone ages. All which still possessed splendour retained it, and the moon added a degree of loveliness to that which really possessed none.

4. Parse the words printed in italics in the above extract.

me, pers. pro., reflect., sing. 1st, com., obj., gov. by *remember*.
moon, com. noun, sing. 2nd, neu., nom. of address.
all, def. num. adj., qual. pro. *this* attributively.
this, demons. pro., sing., 3rd, neu., obj., gov. by *upon*.
cast, verb (cast, cast), irreg., strong, trans., act., infin., gov. by (*didst*) and govg. *light* in obj. case.
down, adv. of man (deg), mod. *softened*.
as, conj., adv., mod. *filled* and introducing subord. sent.
it, impers. pro., sing., 3rd., neu., nom., sub. to *were*.
were, verb (am, was, been), irreg., def. intrans., sub., past., sing., 3rd, agrees with subject *it*.
anew, adv., used adjectly., qual. *it* predicatively.

5. State how you may know, by the spelling of certain words, that they are probably derived from the Greek language. Give some examples.

If the words have Greek prefixes, they are generally of Greek origin, as :—(*a*) *an*-archy, *apo*-logy, *ex*-odus, *epi*-taph.

(*b*) Also if they have Greek roots (*e.g.*), (anthropo=man) philanthropist; (phon=sound) phonetic; (helio=sun) perihelion; (ode=song) parody.

(*c*) If they have Greek suffixes they are generally of *Greek origin*:—(*ac*) maniac ; (*ic*) music ; (*isk*) asterisk ; (*ma*) panorama.

The above is the case except in hybrids (*e.g.*), *martyrdom*—martyr (Gr.), dom (Sax.)

A considerable number of Greek words are terms connected with arts, sciences, and literature; as music, geography, poetry.

6. Explain the origin and precise meaning of seven of the following words, and put each of them into a sentence—

Telephone, Tripartite, Omniscient, Innumerable, Recompense, Philosopher, Quadrilateral, Comprehension, Prosecute, Simulate, Illicit, Cohesion, Legislate.

Word.	Prefix.	Root.	Affix.	Meaning.	Sentence.
Telephone (Gr.)	tele = afar off	phone, a sound	——	An instrument which conveys sound a great distance	Our offices are connected by the telephone
Omniscient (L.)	omnis = all	scire, to know	ent = state, quality	one who knows everything	God is omniscient
Innumerable (L.)	in = not	numerus, a number	able = power	cannot be numbered	The stars are innumerable
Recompense (L.)	re, again	compensare, to compensate	——	a reward	It was a fit recompense for his services
Quadrilateral (L.)	quatuor = 4	latus, side	al = of	a figure of four sides	A square is a quadrilateral
Comprehension (L.)	com, with	prehendo, I grasp	sion, state	power of understanding	It was difficult of comprehension
Legislate (L.)	——	lex legis = law	ate (verbal), to make	to make a law	Members of Parliament legislate for England

7. Take any two of the following writers, and say who and what he was, when he lived, and what he wrote:—Hume, Dryden, Burke, Wordsworth.

Hume (1711–1776) was born in Edinburgh. He was poorly educated, and after abandoning the study of the law, devoted himself to literary pursuits. In 1763 he was Secretary of the British Embassy to France. There he imbibed many of the sentiments and tastes of the leading French men of letters. He returned to Scotland in 1766. His chief works were:—'History of England'; 'Essays, Moral and Political'. He is one of the chief English historians, and his style is clear, easy, and attractive.

Dryden (1631–1700) was a poet and dramatist; he was born in Northamptonshire and educated at Cambridge. Chas. II. made him Poet Laureate, with an annual salary of £200 as a reward for his poems celebrating the Restoration. On James II.'s accession he became a Roman Catholic. He was deprived of his pension at the Revolution. In satirical verse he is unrivalled. His chief works are:—'Translation of Virgil'; 'Absalom and Achitophel'; 'Hind and Panther'; 'Essays on Dramatic Poesy.'

Burke (1730–1797), 'the philosophical statesman,' was born at Dublin and educated at Trinity College. Giving up law, he studied literature, and wrote an 'Essay on the Sublime and Beautiful.' He distinguished himself as the finest orator of the day as a member of the Commons. He opposed the taxation of America, led the impeachment of Warren Hastings, and denounced the French Revolution. His chief works, beside the above, are:—'Reflections on the French Revolution'; 'On the Cause of the Present Discontent'; 'Letters on a Regicide'; 'Peace.'

Wordsworth (1770–1850), one of our greatest poets, was born in Cumberland. He was educated at Cambridge, and visited France during the Revolution. His first poem, issued in 1793, did not suit the public; coming to reside in the south of England, he became acquainted with Coleridge. After a tour in Germany he settled down in the Lake District. Amongst his poems were:—'The Excursion'; 'The Wagoner'; 'The Prelude'; Sonnets; 'Ode on Immortality'; 'Lucy Grey'; 'We are Seven'; 'The Pet Lamb'; etc. His style is very natural and simple.

8. What is meant by a figure of speech? Give some examples of the use of figurative language from poems you have read.

A figure of speech is a name given to words when they are used in a sense different from the usual sense.

They are employed by writers to embellish and illustrate the different subjects of which they treat.

'*Shakespeare*' uses this *simile*—

'It droppeth *as gentle rain* from heaven
Upon the place beneath.'

'*Mrs. Hemans*' makes use of this *metaphor*—

'He lived, for life may long be borne
Ere *sorrow breaks its chain*.'

Our Lord's Parables were chiefly *allegories*; so also is 'Pilgrim's Progress' (Bunyan).

Personification (Byron)—

'There was a sound of revelry by night,
And Belgium's capital *had gathered* then
Her beauty and *her* chivalry.'

Antithesis (Proverbs)—

'A *soft answer* turneth away wrath,
but a *grievous word* stirreth up anger.'

Climax (Byron)—

'And *nearer, clearer, deadlier* than before.'

9. Suppose we had an alphabet in which each separate sound was represented by a separate letter; what and how many additional vowels and consonants should we require? Give some examples, showing how the same letter often represents different sounds.

There are 43 sounds, but only 26 letters. We have 5 vowels and 14 simple vowel sounds. We should, therefore, require 9 more simple vowels.

We have 21 consonants and 29 consonantal sounds, so we should want 8 more consonants.

Of 'a.'	Of 'e.'	Of 'i.'	Of 'o.'	Of 'u.'
(1) Marry.	(1) Set.	(1) Fit.	(1) Rot.	(1) But.
(2) Mary.	(2) Sere.		(2) Rote.	(2) Mule.
(3) Bar.				(3) Fur.
(4) Ball.				(4) Hull.
(5) Mate.				

C has two sounds, icicle (soft and hard). *G* is hard before *a*, *o*, *u*, *n*, *l*, *r*, and soft before *e*, *i*, and *y*, as *gigantic*.
S has two sounds, *cats*, *houses*.

10. Give examples of each of the following, and some rules for its right use :—

The nominative absolute.
The subjunctive mood.
The gerundial infinitive.
The double negative.

The *Nom. Absolute* is used as a substitute for an Adverbial Sent., *as*—

(1) The *cat* being away, the mice will play = when the cat is away, &c.
(2) His *opponent* having been wounded he was satisfied. = When his opponent was wounded. In Latin the Absolute case is the Ablative, in Greek the Genitive, in Anglo-Saxon the Dative.

The *Subj. Mood* is used to express a *doubt*, *possibility*, *wish*, *purpose*, &c. (*e.g.*), If this *be* so he will return. Suppose it *were* so.

Gerundial-Infinitive is used as—.

(1) Subj. of a verb (noun). To *sing* a song is pleasant.
Obj. of a verb (noun). I like *to read* a book.
(2) Complex obj. of a verb. I like a thief *to be caught*.
(3) With a noun = (Adj.). A house *to let*.
(4) With a Verb = (Adv.). Apples good *to eat*.

Note.—It would be better if grammarians would use 2, 3, and 4 as *Gerundial Infin.* and No. 1 the Infinitive Gerund, since '*to sing*' and '*to read*' have both a Nounal and Verbal Force.

The rule of Syntax is that a Double Negative makes an Affirmative. Therefore '*I do not want none* = I do want *some*.' It is used to render an assertion less emphatic.

IMPORTANT NOTICE.—Next month all the remaining Scholarship Model Answers will be inserted, and '*The* 1894 *Scholarship Examination*' Articles will be commenced. We have made arrangements for tuition based upon these Articles by experienced teachers and graduates. Names of intending pupils should be sent in at once to *Dr. George Beach, M.A., Stanley Mount, Macclesfield.* The fees, to be paid in advance, are 1s. 6d. per week, 5s. 6d. per month, 15s. 9d. per quarter, or £2 10s. the complete course.

NOTES ON QUICK'S EDUCATIONAL REFORMERS.

(Special Subject set for Second-Year Certificate Students, Christmas 1893.)

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.)
Author of 'Mental Science and Logic for Teachers,' etc. Co-Director of the Birkbeck Training Classes, and Lecturer therein on School Method.

ESSAY XVI.—PESTALOZZI.—(*Continued.*)

UNDER Iselin's auspices Pestalozzi wrote in the 'Ephemerides' reflections called 'The Evening Hour of a Hermit,' which constituted at the same time 'the fruit of his past years and the seed-corn of the years that were to come, the plan and key to his action in pedagogy' (Fischer). The substance of these aphorisms is contained in the following: 'Nature brings out all men's powers by practice, and their increase springs from use.' 'All wisdom of man rests in the strength of a good heart that follows after truth, and all the blessings of man in the sense of simplicity and innocence.' Peace of mind must be the outcome of right training. To get out of his surroundings all he needs for life and enjoyment, to be patient, painstaking, and in every difficulty trustful to the love of the Heavenly Father, this comes of a man's true education in wisdom. Nothing concerns the human race so closely and intimately as God. 'Evening Hour' naturally unattractive. At the suggestion of his friends, 'Leonard and Gertrude' written, a tale depicting Swiss peasant life with artistic skill and with a truthfulness begotten of earnest sympathy and persistent study. 'In that which I here relate, and which I have, for the most part, seen and heard myself in the course of an active life, I have taken care not once to add my own opinion to what I saw and heard the people themselves saying, feeling, believing, judging, and attempting.' (Preface to first edition.) 'I desired nothing then, and I desire nothing else now, as the object of my life, but the welfare of the people whom I love and whom I feel to be miserable as few feel them to be miserable, because I have, with them, borne their sufferings as few have borne them.' Thanks and a gold medal from Bern Agricultural Society showed what an impression 'Leonard and Gertrude' had made, which impression was universal, and Pestalozzi was regarded as a man who really understood how to tackle the difficult problem, viz., how to ameliorate the peasant's lot. In this classic are portrayed the salient points of his experiment at Neuhof: (1) the love and patience with which Gertrude bore with the disorderly and untrained little ones were almost past belief; (2) unable to explain her words, Gertrude would let fall some significant remark which went to the root of the whole matter of education; (3) reading, writing, and arithmetic are not, after all, what they most need. It is well and good for them to learn something, but the really important thing for them is *to be something*; (4) of what use is it for a person to be able to read and write if he cannot speak, since reading and writing are only an artificial sort of speech? . . . The schoolmaster taught them to see and hear with accuracy, and cultivated their powers of attention. Here is his idea of what a Commission on education should be like: It should include men of all shades of experience, not even excepting the schoolmaster and *women of different ranks and conditions of life.* In 1782 appeared 'Christopher and Eliza,' 'my second book for the People.' It was a failure, although on the same lines as 'Leonard and Gertrude.' To catch the public ear Pestalozzi now added 'continuations' to 'Leonard and Gertrude,' and so spoilt its success in becoming more and more didactic and less and less popular in his style of exposition. The 'Swiss Journal,' lasting through 1782, was his next literary attempt. *Inter alia* we are told that 'To engage the attention of the child, to exercise his judgment, to raise his heart to noble sentiments, are the chief ends of education.' This development is to be brought about by the exercise of the child's mind on his surroundings. Here also we find the following: 'Teach me, summer day, that man, formed from the dust of the earth, grows and ripens *like the plant rooted in the soil.* (*Cf.* Kindergarten.) From 1787 to 1797 nothing was published. The latter year saw 'Inquiry into the Course of Nature in the Development of the Human Race' written. It was prolix and obscure, and therefore was neglected. 'Figures to my A B C Book,' or, to use the later title, 'Fables: a series of apologues as witty and wise as those of Lessing,' was also neglected, although it was a good book, in proof of which carefully read 'The Two Colts.' Soon after this the Stanz experiment was made, before which is described a brief account of the outcome of Pestalozzi's

thought up to 1798—that is, the period of his unaided activity; (*a*) education the only hope for making men less poor and less degraded; (*b*) in worst children even, are the seeds of a wealth of faculties, sentiments, tastes, and capabilities which, if developed, might make them reasonable and upright human beings; (*c*) education to begin in the child and work *from within outwards*—hence, 'nature develops all the powers of humanity by exercising them' became his rule; (*d*) no means can be found of exercising the higher faculties which can be compared with the actual relations of daily life; (*e*) there must be thorough mastery of the first elements. The schools hastily substitute an artificial method of words for the true method of nature, which knows no hurry, but waits. The following, according to M. Guimps, is Pestalozzi's fundamental principle of education: 'All the real knowledge, useful powers, and noble sentiments that a man can acquire are but the extension of his individuality by the development of the powers and faculties that God has put in him, and by their assimilation of the elements supplied by the outer world. There exists for this development and the work of assimilation a natural and necessary order; an order which the school mostly sets at nought.

Next month we shall consider the Stanz experiment.

CONVERSATIONAL LESSONS IN CHEMISTRY.

BY THOMAS CARTWRIGHT, B.A., B.SC.(LOND.).

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FOR particulars of the List of Chemicals and PRACTICAL TEACHER Set of Apparatus for working the experiments referred to in these lessons see numbers for January and February, 1893.

LESSON VIII.—*Carbon Monoxide.*

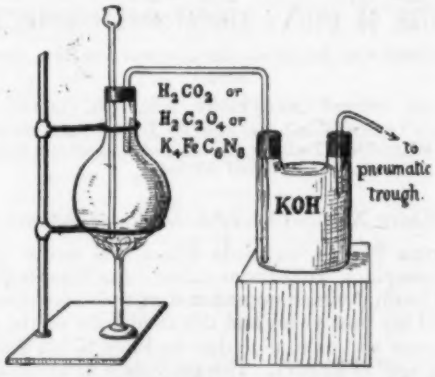
In our last lesson the dioxide of carbon (CO_2) was the object of our study; let us now give our attention to carbon monoxide (CO). See here, Charlie, is a jar of the body, and I want to see what progress you have made in the art of observing. Proceed now to tell us all that a cursory examination tells you of the prisoner of the bottle? Well, sir, my eyes tell me that it is an invisible gas, my nose tells me, now that I have taken off the glass plate, that it has a faint oppressive odour, and it is a neutral body, for both the blue and the red strips of litmus paper, which you saw me drop in, remain unaltered. Your attempt is quite a success, Charlie; before we can go any further we must prepare some more of the gas; but I should like you to exercise your ingenuity in trying to suggest a good method for the preparation of CO. Now, Arthur, you begin. Burn carbon in air or oxygen, sir? Ah, but the carbon will not take up one atom of carbon only, but will become CO_2 by combining with two atoms of O if precautions be not taken to prevent this. Now, George, what do you recommend? It seems to me, sir, that CO_2 would not be produced if there was plenty of carbon and little of O. That is very good, but a little reflection will show you that we could not readily get rid of all the O, so that we should probably have a mixture of O, CO_2, and CO. As we want CO only, this will not answer our purpose. Still, please remember well that CO is produced when C burns in a limited supply of air or O, and that CO_2 results from the combustion of C in an unlimited supply of air. Now, I will show you how I obtained the gas which Charlie examined. Look at this liquid. You will notice that it is labelled 'Formic Acid,' and you will be interested to learn that, although produced artificially in the laboratory, it is exactly similar to the liquid with which the ant charges her sting. As the Latin name for the ant is formica, the name of the acid itself suggests the connection which I have just now mentioned. Now, Frank, please fit up a flask with thistle funnel and leading tube, and conduct the latter under the bee-hive shelf of the pneumatic trough, taking care to cover the shelf well with water. Tom shall pour a small portion of the formic acid down the thistle funnel, to be followed by sufficient strong H_2SO_4 to well immerse the bottom of the thistle funnel in the liquid. What are those bubbles of gas, Arthur? First of all there will be the air, sir, which is driven out of the flask, and then I suppose the CO will be given of. As usual, you are right, and you can readily understand what takes place if you will recollect that H_2SO_4 has great affinity for water, and will extract the elements of water from many bodies containing H and O. Now, formic acid is H_2CO_2, and the strong H_2SO_4 decomposes this into H_2O, which it absorbs, and CO, which is given off. As the H_2SO_4 remains unaltered, we express the result in the following equation:—

$$H_2CO_2 = H_2O + CO.$$

As formic acid is dear, we shall not again prepare our CO by this method, although it is, perhaps, the very best way to obtain pure CO. Here is another acid—a solid. Look at the bottle, Fred, and read the name for us. It is oxalic acid, sir. Yes, and you may have seen it used for removing ink-stains. You must be very careful with it, as it is a deadly poison. If you treat oxalic acid as you did formic, your jars will again contain CO; but not CO alone, as the equation which follows will show:—

$$H_2C_2O_4 = H_2O + CO_2 + CO.$$

Now, Annie, how can we get rid of the CO_2? Well, I will help you a little by asking you what we must pass the mixed gas through, in order that the CO_2 may be taken and the CO left? Ah, I see you do not remember, so we will let Tom try. Pass the mixture through caustic potash (KOH) and the CO_2 will be absorbed, but I do not know whether the CO will be left. Your method is perfectly correct, and is the one actually in use; the only addition to our apparatus will be the inclusion of a Wolff's bottle, containing a strong solution of KOH, as shown on the board.



Another way of preparing the monoxide is by the action of strong H_2SO_4, or yellow prussiate of potash—this toffee-like stuff which I here have; but it is now time to continue our examination of the CO, so here is a jar for you, Annie. But first tell me what you will do with it, or rather I will tell you what you must not do with it. Do not inhale it, as it is a most deadly poison, and the least result from inhalation would be a severe headache. May I try it with lime-water, sir? As you please. It does not turn it milky, sir, and so it differs from CO_2. Quite right. Now for your experiment, Bertie. I shall try to burn it, sir, like we did the H. Just as you like, but pray look before you leap, and endeavour to foresee what should be the body formed, supposing the CO does burn in air. Shall I put it in an equation, sir? I shall be delighted if you will, as much time will be saved thereby. Is

this correct, sir?—$CO + O = CO_2$. Now, boys and girls, do you think I ought to answer such a question? No, sir; for if he gets CO_2 the lime-water will say "Yes" or "No." All being now ready, Master Bertie, please fire away. What a pretty blue flame! It is almost like the H flame. I was right, sir; for see, I have poured in the lime-water, and shaken it up, and there is no trace of milkiness. Carefully note what you have done, and be sure to understand it now, and it will be easier for you to remember. Now let us see if we can return the compliment, and convert CO_2 into CO. We shall require the apparatus which we used in preparing H from water by the agency of iron filings (see Lesson II.), but instead of passing a stream of steam over red-hot filings, we must pass a stream of CO_2 over red-hot charcoal, when the red-hot carbon will reduce the dioxide to monoxide. James shall give us the equation—

$$CO_2 + C = 2CO.$$

Quite right, and now let us turn to our fire, and see what we can learn from it. At the bottom of the fire there will be plenty of O, and you can readily guess what will be formed, viz., CO_2. In the middle of the fire we shall have red-hot coal, which will reduce the CO_2 to CO. At the top of the grate again the supply of air will be unlimited, and the CO will burn, forming CO_2. If this is correct, you tell me, Mary, what you would expect to see at the top of a clear fire? I can tell you, sir; you would find a blue flame, similar to that which we have just now seen, and that is exactly what we do see. Very good; and when you again see the blue flame in your fire, think that

$$CO_2 + C = 2CO, \text{ and}$$
$$CO + O = CO_2.$$

In burning CO to form CO_2 great heat is evolved, hence CO is a valuable fuel, used much in smelting operations. In what respects, Charlie, are CO and H alike, and how could you tell one from the other? I can easily solve that riddle, sir. They are alike in being combustible bodies, and in burning with a nearly colourless blue flame. H, however, burns to form H_2O, which has no effect upon lime-water, whereas CO burns to form CO_2, which, of course, turns lime-water milky. Very good; and now think well over this lesson, in order that it may help you to get as much profit and pleasure out of other lessons founded upon it.

SCIENCE NOTES.

A New Series of Colouring Matters.—M. Trillat has recently succeeded in obtaining a new series of colours by investigating the action of formic aldehyde upon the derivatives of triphenymethane and other colouring matters. While rosaniline yields a fine violet product which is unfortunately very unstable in the presence of light, crystalline salts are formed by safranine, possessing a brilliant metallic appearance, and having the property of readily dyeing silk, wool, and cotton, without the aid of mordants. M. Trillat finds that formaldehyde reacts freely with simple and compound amines of the aromatic series, in which at least one atom of hydrogen is replaceable, while the shades of the amido colouring matters are profoundly modified by the substitution, being changed generally in a direction corresponding to the right with regard to the colours of the spectrum.

***

The Influence of High Temperatures on Disinfectants.—The bactericidal properties of the majority of disinfectants are found by Heider to be greatly increased by their being employed at high temperatures. While anthrax spores were destroyed in the course of less than two hours in a 5 per cent. solution of carbolic acid at 55°, a 1 per cent. solution at a temperature of 75° destroyed the germs in two hours and a half. These results being confirmed by experiments with other disinfectants under similar conditions, Heider concludes that hot or even boiling solutions are best employed to effect the destruction of spores. Besides the great saving of time thus secured, a considerable economy of material is gained, less concentrated solutions being required.

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The Effect of Cold Baths on the Blood Corpuscles.—Some interesting investigations as to the increase of leucocytes in the blood after cold baths have been lately published by Dr. Thayer. It has been found as the result of experiments at the John Hopkins' Hospital that both in normal individuals and fever patients there is an appreciable increase of the white corpuscles as early as half-an-hour after the exposure to cold water. Cold baths, it would seem, cause no constant change either in the numbers or appearance of the red corpuscles.

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New Sources of Alcohol.—It has long been known that the convertibility of cellulose into sugar admits of its being made a source of alcohol, and several attempts have been made to thus obtain alcohol from wood. Owing to the compact texture of this substance the processes employed have been of too costly a nature to render their practical adoption profitable. A more successful result is now found to be gained by operating upon cellulose of a naturally more open texture. Peat moss was heated to a temperature of 115° to 120° C. with dilute sulphuric acid for four or five hours in order to convert the cellulose into sugar. The expressed liquor was then fermented with yeast and subsequently submitted to distillation. It is claimed that turf may henceforth compete favourably with potatoes as a source of alcohol, a thousand kilos of dry turf yielding from 62 to 63 litres of absolute alcohol, while 500 kilos of potatoes, containing 20 per cent. of starch, yield at the outside only 60 to 61 litres of absolute alcohol. It is interesting in this connection to note that M. Lévy has succeeded in producing alcohol by the fermentation of artichoke tubers through the agency of pure yeast. Attention has already been drawn in these columns to the fact that inulin may be converted into a fermentable sugar by the action of a ferment, trehalase, found associated with it in these tubers. M. Lévy treats the washed and sliced tubers with four times their weight of water at 60°, and containing two parts in a thousand of potassium bitartrate. After decantation of the first portion of liquid, the process is repeated. The resulting solutions are mixed and the wort sterilized by heating it to the boiling point three times on successive days. The yeast then being added, the fermentation proceeds rapidly, a current of sterilized air hastening the process. At a temperature of 20° to 25° the fermentation is complete in three days, when the alcohol is separated by distillation.

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Drinking-water and Bacteria.—In view of the spread of cholera, the relations of drinking-water and bacteria have recently been engaging the attention of German scientists. Dr. Gottstein suggests that the decomposition of hydrogen peroxide and the resulting evolution of gas under the influence of bacteria may be made a means of testing the condition of water, since the effect produced is proportionate to the number of bacteria present. With ten thousand in the cubic centimetre, a brisk disengagement of gas occurs, and the evolution is distinctly recognisable when there are only one thousand in the cubic centimetre. In the laboratories of the Hygienic Institute at Munich, Dr. Harvey Attfield has been instituting a number of experiments to ascertain whether infusoria have anything to do with the so-called self-purification of foul water. To water from a disused well, which was almost free from infusoria, but which contained as many as ten thousand bacteria per cent., a small proportion of water from the Isar river, swarming with infusoria, was added. It was found that the bacteria decreased to less than one-fifth of their original number in six days, whereas the well-water, to which no water from the river was added, showed a decrease of only fifty per cent. in the same length of time. Very similar results were obtained when filtered air was driven through the fluids. In one instance, water containing three million of bacteria per cent., together with infusoria, after an interval of ten days contained only a little over thirteen thousand. During the same time the bacterial contents of a sample of well water without infusoria rose from seven hundred to over a hundred and twenty thousand. It would seem from these experiments that in the presence of infusoria some powerful influence is exerted in the direction of ridding the water of bacteria.

GLYCERIN AS A BACTERICIDE.—Recent experiments of Dr. Copeman appear to show that all saprophytic and many pathogenic organisms are destroyed in the presence of glycerin in a space of time varying from three or four days to the same number of weeks. For sixty-seven days the diplococcus of Fränkel preserved its virulence in glycerin. The bacillus of fowl cholera was killed by four months' contact with glycerin. The virulence of anthrax gradually decreased, ceasing on the seventh day in one experiment, and on the ninth in another. Dr. Copeman advocates the addition of glycerin to lymph, claiming for the mixture that it dries up less readily than ordinary lymph, retains its properties unimpaired, and in process of time increases in potency.

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Art Master under the London School Board.

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C shows all the six; two of them, *a* and *d*, being at the back of the solid figure, are dotted lines.

II. From elevations similar to those at A and B (I.) obtain the plans. The size of the hexagonal ends is not given.

A. Draw projectors from the elevation, and a centre line. Fix any point on the centre line for the centre *o*. Draw *ab* parallel to *xy*. As the elevation shows the extreme width of the figure, *ab* will be the diameter of the circle required. Draw it, and join the points in which it cuts the projectors.

Refer to I. and note that the width in elevation is not equal to the diameter of the circle in the plan. To obtain the radius fix a centre *o*, and with the set square make an angle at *o* of 60°. This will give *oa* and *a*. On one of the projectors is one of the corners of the hexagon. With radius *oa* draw the circle, which will show the other five corners on the projectors.

C. To obtain the plan from the elevation in C (I.). In this case the size of the hexagon must be given, or the problem becomes too difficult for the class.

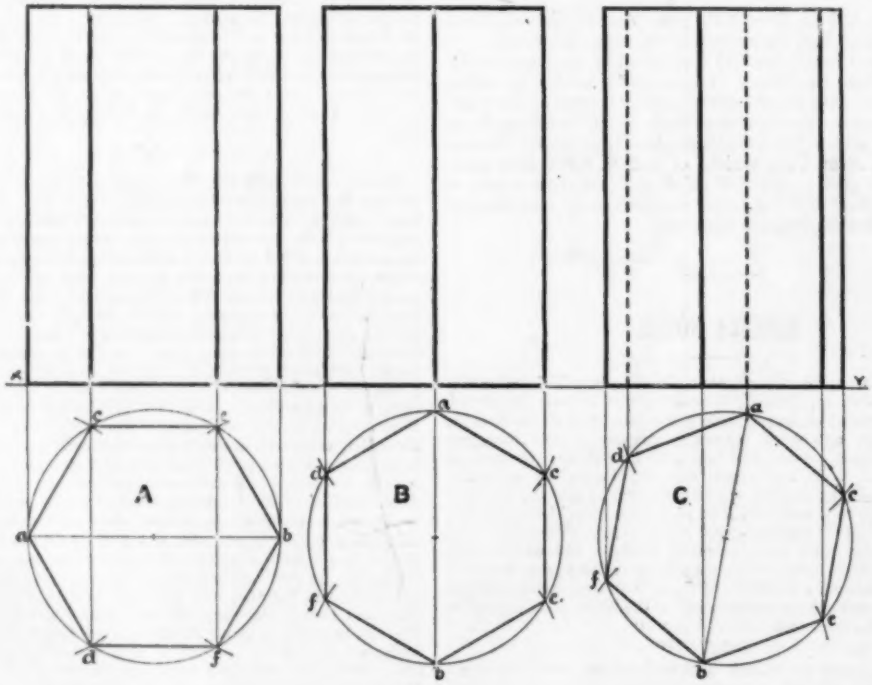

Fig. 1.

Fix a centre *o*, and with the given radius draw the circle, cutting the six projectors in the six required points.

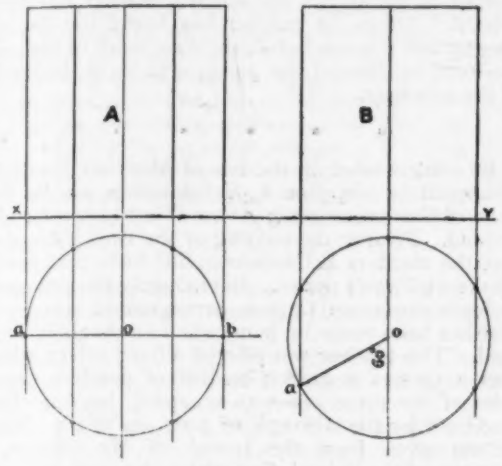

Fig. 2.

III. Hexagonal prism, tilted so that the base is inclined 60° to the horizontal plane, and the long edges are parallel to the vertical plane. Length, $2\frac{3}{4}$"; sides of hexagon, 1".

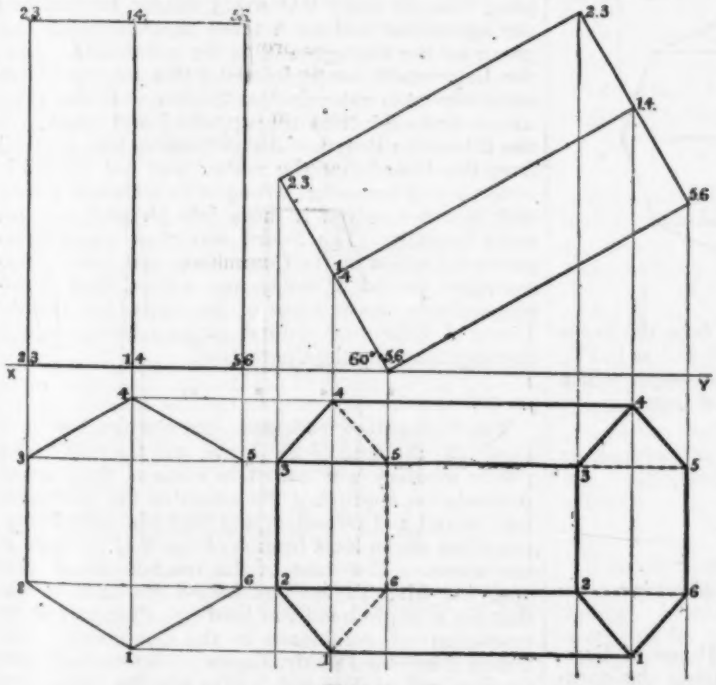

Fig. 3.

Draw first a plan and elevation similar to I., B. Copy the elevation by drawing the base at 45° to *xy*, and making the long edges at right angles to the base. Take exact measurements from the first elevation to get the second. In the first the solid stands upright on the ground; in the second it is tilted at an angle of 45°, but the shape and size are in no way altered.

Before proceeding with the second plan it must be understood, and seen by reference to the model, that tipping up the figure in a direction parallel to the vertical plane makes no alteration in the dimensions of the plan at right angles to *xy*; *i.e.*, the lines 2—3, 1—4, and 5—6 remain of the same length as before.

The numbers 1 to 6 in the plan are used in elevation for both hexagonal ends of the prism.

To obtain the second plan.—Keep in mind that there will be two hexagons shown, and take the top first. Draw a projector downwards from 5—6, and from 5—6 in the first plan draw parallels to meet the projector in two points, which will be 5—6 in the new plan. Draw a similar projector from 1—4, and parallels from 1—4 in the old plan to meet this projector, and mark 1—4 in the new plan. Get 2—3 in the same way. These six points joined by straight lines will give a hexagonal figure—the plan of the upper end of the prism.

For the lower end the work is precisely similar, the same parallels being used. In joining the points be careful to make the lines meeting at 5 and 6 dotted. These two corners rest on the ground; they are the lowest parts of the figure, and will be out of sight when the solid is viewed from above.

Join 4—4, 3—3, 2—2, and 1—1 by thick lines, and 5—5, and 6—6 by dotted lines. Part of the dotted lines will probably be covered and hidden by the thick lines.

Notice again that all the distances measured downwards from *xy* correspond in the two plans.

IV. A is the elevation of an octagonal prism, resting with one *corner* on the ground. Draw the plan.

The hexagonal prism in I., position A, when tipped up on *one corner*, will serve for illustration. The *width* of the elevation is the diameter of the circle containing the octagon.

An *auxiliary or helping* plan must first be obtained. If the elevation A were set upright on *xy*, as is the first elevation in IV., its corresponding plan might be obtained as shown in II., A, and the problem finished as in IV. But it is unnecessary to repeat the elevation given. Turn the paper round and consider IL as the ground-line, draw projectors at right angles to IL, fix *o* as centre and draw the circle—on which the projectors will mark points 1 to 8. Join the points to form the octagon. This is the auxiliary plan, by the help of which the required plan can be drawn.

Every point in the auxiliary plan must be transferred to the new plan by measuring the distance from IL of the one, and marking the same distance from *xy* to fix the other. Take one point first as an example. From 5, the top corner of the elevation, draw a projector perpendicular to *xy*. Measure *ab*, the distance of 5 in the auxiliary plan from IL, and transfer it to *cd*, marking *d* as point 5 in the new plan. Next draw a projector from *e* (4 and 6). Mark on this projector two points, *lm* and *ln*, taken from *cf*

and *eg*. Continue this process till the upper end of the elevation is shown in the new plan as a flattened

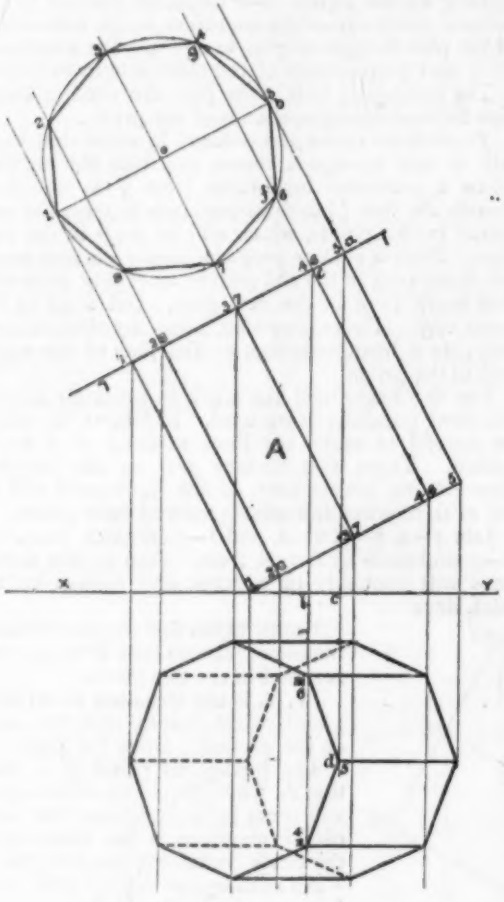

Fig. 4.

octagon then obtain a similar figure from the lower end. The problem can then be completed as in IV., great care being taken to indicate all edges which could not be seen from above by dotted lines.

NOTES AND NOTIONS.

BY RICHARD WADDINGTON,
Ex-President of the Half-Time Council of Teachers.

MR. ACLAND has announced in the House of Commons that the Government is considering the question of Security of Tenure. That any Minister of Education could tolerate a continuance of such scandals as Arlington, St. Stythians, and Wimblington, is impossible. From the anxiety of the teachers it is safe to say that only a very small fraction of the cases receive publicity.

'What's done we partly may compute,
But know not what's resisted.'

The case is too acute to admit of procrastination. Year in, year out, the teacher has been subject to the caprice of the small School Board or the almost ubiquitous manager. Irrespective of the educational welfare of the district the efficient teacher has been evicted. Often the teacher has borne the trouble silently lest a worse befall, since so much of the professional welfare of the pedagogue is in the hands of the manager.

* * * * *

BUT the teacher in the Isle of Man has the right of appeal to the Board of Education, and in the town of Castletown there is an object lesson for Mr. Acland. Prior to the passing of the Free Education Act the teachers at Castletown had been paid partly by the children's pence. Immediately the Act came in force the same little re-arrangement was made that has been made in hundreds of schools in England. The teacher was offered a fixed salary, which was a serious reduction on that of previous years. Two of the three teachers accepted, but the third stood out for the average of previous years. Now, let me quote from the speech of Mr. Martin, a member of the School Committee that resigned because the Board of Education took the side of the teacher. He said :—'Each of the teachers held their position subject to three months' notice being given on either side, and the Committee, acting within their rights, after duly considering the matter in dispute, thought there was every reason to terminate the agreement, and so a three months' notice was given for the engagement to be terminated. Now, the Legislature has appointed it that no removal or appointment of any principal teacher shall take place unless first subject to the approval and sanction of the Education Board. An intimation was received from the Board that the matter was not strictly in order, being somewhat wrong in its technical details, and in order to put it more into shape it was put more formally. The Board was then asked to approve the action of the Committee, and after a considerable period of delay, and a good deal of correspondence, the outcome of the matter was that the Board of Education did not express its approval of the step taken by the Committee.

* * * * *

THE Committee resigned—not the teacher as is usual in 'the land of the brave and the free,' and a public meeting was called to endorse their action. A resolution approving the action of the Committee was moved and seconded, and then Mr. John Taylor, president of the local branch of the N.U.T., came on the scene. The case of the teacher was a good one, but Mr. Taylor marshalled his facts so well that not a single hand was held up in support of the resolution of confidence in the Committee. The Union is indebted to Mr. Taylor for his courage, pertinacity, and ability, and I offer him my hearty congratulations on the success of his defence of the teacher. When will this be possible in England, Mr. Acland?

* * * * *

AROUND Bolton it is customary to set one Sunday a year aside for the 'School Sermons.' It is somewhat of a red-letter day, or, more appropriately, 'white-letter day,' since the little girls are dressed

in white, and large sums are collected for school expenses, ranging from £50 to £300. Many of you will have heard the story of the man who was discovered sitting in the hedge on a wet Saturday night, and who, on being accosted by a friend, said, 'Houd th' noise, it's our sermons i' t' morn, and I'm getting ready to sing bass.' But as I was walking through a village outside Bolton the other Sunday evening I met two happy-looking gentlemen carrying the collection money through the village. The bag was fastened to a walking stick, which was used as a pole, and reminded me of Joshua's two faithful spies returning from the Promised Land laden with fruit.

* * * * *

THE stringing-up process with the Drawing is likely to lead to unpleasant results. There would appear to be little doubt that the word has gone forth to endeavour to force classification by age. The instruction that no child over eight years of age in the first standard, and no child over nine in the second standard is to receive a higher mark than 'Good,' is a direct breach of faith. In reply to the deputation from the N. U. T. on March 5th, 1892, Sir William Hart Dyke said:—'It is the intention of the Department that there should be absolute freedom of classification in regard to Drawing, and I have only to say that if the rules and regulations do not bring about that result, I for one can promise that we shall be most glad to consider them.' And again, on the same occasion, when pressed by Mr. Wild, he said:—'I have not the least reservation with regard to that; and if our present regulations do not carry that out, they shall be amended so as to secure it.' And not less emphatic was the statement of the Secretary to the Science and Art Department on another occasion.

* * * * *

THE Alternative Course in Arithmetic in the New Code means a good deal more than appears at first sight. There seemed a possibility of the fourth and higher standards being unduly loaded. With a view to elucidating this point, I wrote to the Department asking the following questions:—

'1. Does "reduction and compound rules applied to the following weights and measures for Standard IV." mean that the four rules must be mastered in addition to reduction; *i.e.*, would the following be within the requirements: 15 tons 13 cwts. 3 qrs. 11 lbs. ÷ 27?

'2. And in the fifth standard does common weights and measures include such problems as 3 acres 2 rds. 15 ps. 27¼ sq. yds. ÷ 137?'

The answer is—

'Adverting to your letter dated the 7th inst., I am directed to inform you, in reply to your first inquiry, that the sum "15 tons 13 cwts. 3 qrs. 11 lbs. ÷ 27" would be within the requirements under the present Code for Boys and Girls in Standard IV. In reply to your second inquiry, the sum "3 acres 2 rds. 15 pls. 27¼ sq. yds. ÷ 137" would be within the requirements for Boys, but not for Girls.'

And this means that the fourth standard is very much overweighted. But the fifth standard is still more unfairly treated. It is to be regretted that so educational a syllabus for the lower standards is made to press so hardly on the upper standards.

* * * * *

IF the complaints are in any measure an index of the failure of the enforcement of the Compulsory Attendance at school, then irregularity increases day by day. From north, south, east, and west the cry of desperation is borne. When will the Education Department awake to its obligations? Between the inefficiency of the Local Authorities and the indifference of the Magistracy, the thriftless and careless parent is allowed to perpetuate his race. Without more active interference on the part of the Department, the desired improvement is past hoping for. Free Education has failed to improve the attendance. Wherein lies the cure? The problem is not an easy one; but without a much stronger administration of the law, the irregulars will increase. Much might be done to improve the administration by the appointment of Special Inspectors of Attendance, who should have the power to initiate prosecution if necessary. The matter is becoming more important day by day. Managers are anxious, since so much of the income of the school now depends on the average attendance; and the nation is concerned that the money spent on education shall not be frittered away by the gross negligence of indifferent parents. The medical man who would find a cure for Monday morning and Friday afternoon sickness would be a national benefactor.

* * * * *

I HAVE before me a school circular which contains the following:—

'In conclusion, let me point out some of the special features of the school. It is the day school in ————, at which boys and girls are taught shorthand. *Further, Standard I. read and are examined from a Standard II. reading book; also Standard III. read and are examined from a Standard IV reading book.*'

And this circular bears the name of the head master. What next? I only sorrowfully repeat the words of Proverbs xxvii. 22.

* * * * *

THE contest for the Vice-presidency of the N. U. T. is likely to be a keen one. So far Mr. Eilery alone appears in the field, but ere long I anticipate he will find a foeman worthy of his steel in Mr. Macnamara. The admirable way in which my predecessor in these columns has ventilated the wrongs of the oppressed in the columns of 'The Schoolmaster' has done much to redeem the promise made to the Executive on his appointment, that he would endeavour to make the paper a living commission for ventilating the grievances and bettering the position of the teachers throughout the country. The contest will be interesting and good humoured, and I wish them both success.

* * * * *

THE question of the Federation of Assistants is to come up at the Annual Conference of Assistants at Derby. I understand the sub-committee has drafted a scheme for presentation to the Conference. Federation is the right line for assistants—about that, as a strong Unionist, I have no doubt, but it should be federation of the assistants in the N. U. T. The federation of the teachers in half-time and rural districts has done much to aid the work of the Union, and a similar focussing of the views and demands of assistants will strengthen the N. U. T. At present the various Assistants' Associations throughout the country are composed of Unionists and non-Unionists. To bring about a scheme of federation membership of the N. U. T. should be a

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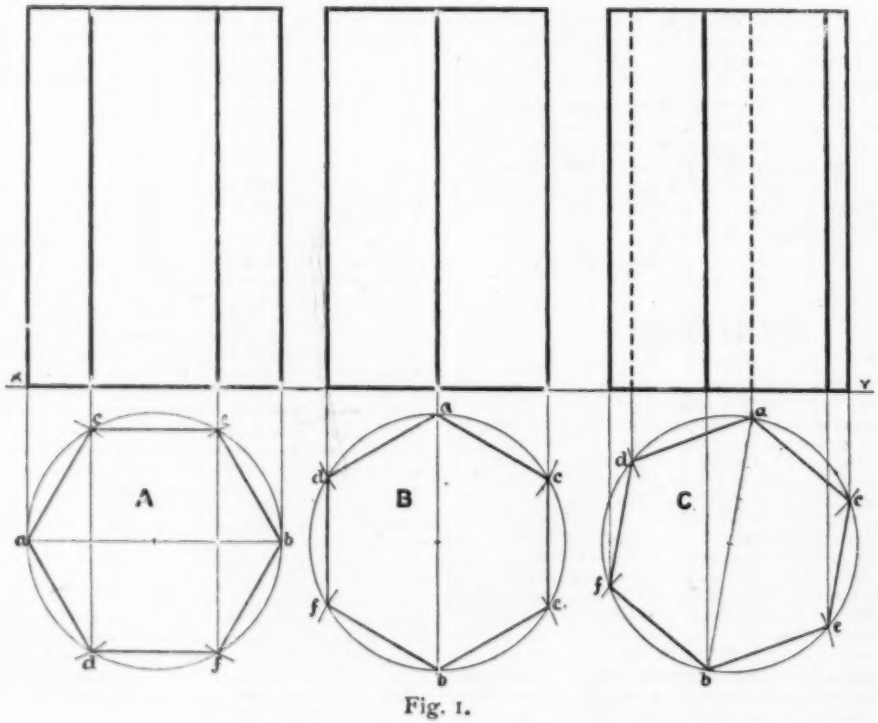

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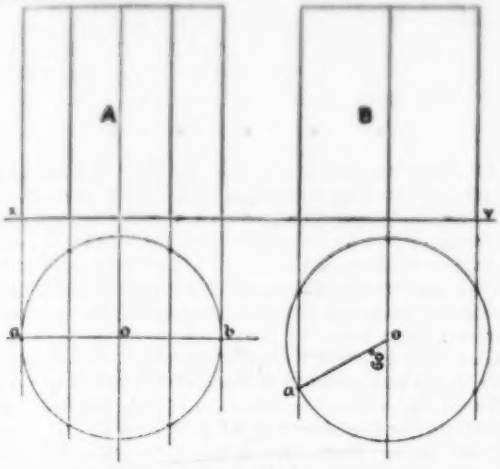

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III. Hexagonal prism, tilted so that the base is inclined 60° to the horizontal plane, and the long edges are parallel to the vertical plane. Length, $2\frac{3}{4}$"; sides of hexagon, 1".

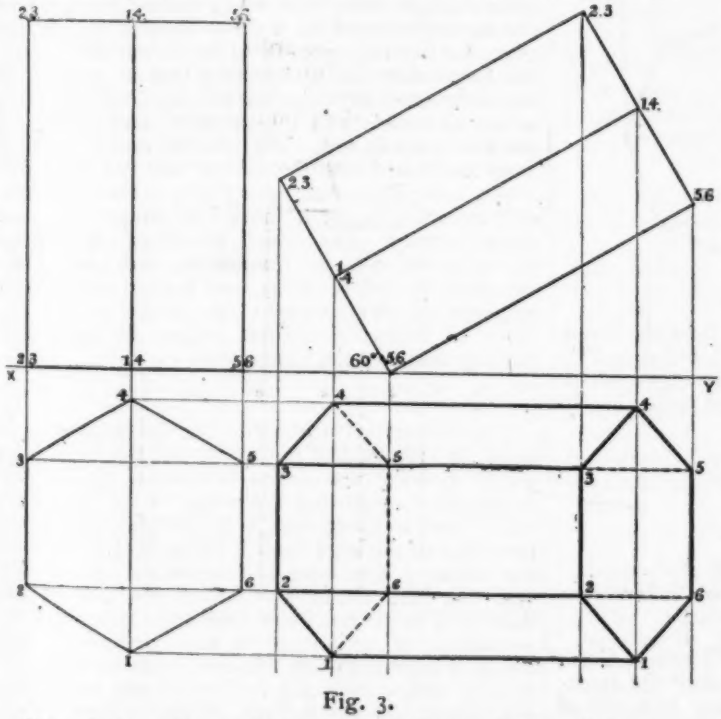


Fig. 3.

Draw first a plan and elevation similar to I., B. Copy the elevation by drawing the base at 45° to *xy*, and making the long edges at right angles to the base. Take exact measurements from the first elevation to get the second. In the first the solid stands upright on the ground; in the second it is tilted at an angle of 45°, but the shape and size are in no way altered.

Before proceeding with the second plan it must be understood, and seen by reference to the model, that tipping up the figure in a direction parallel to the vertical plane makes no alteration in the dimensions of the plan at right angles to *xy*; *i.e.*, the lines 2—3, 1—4, and 5—6 remain of the same length as before.

The numbers 1 to 6 in the plan are used in elevation for both hexagonal ends of the prism.

To obtain the second plan.—Keep in mind that there will be two hexagons shown, and take the top first. Draw a projector downwards from 5—6, and from 5—6 in the first plan draw parallels to meet the projector in two points, which will be 5—6 in the new plan. Draw a similar projector from 1—4, and parallels from 1—4 in the old plan to meet this projector, and mark 1—4 in the new plan. Get 2—3 in the same way. These six points joined by straight lines will give a hexagonal figure—the plan of the upper end of the prism.

For the lower end the work is precisely similar, the same parallels being used. In joining the points be careful to make the lines meeting at 5 and 6 dotted. These two corners rest on the ground; they are the lowest parts of the figure, and will be out of sight when the solid is viewed from above.

Join 4—4, 3—3, 2—2, and 1—1 by thick lines, and 5—5, and 6—6 by dotted lines. Part of the dotted lines will probably be covered and hidden by the thick lines.

Notice again that all the distances measured downwards from *xy* correspond in the two plans.

IV. A is the elevation of an octagonal prism, resting with one *corner* on the ground. Draw the plan.

The hexagonal prism in I., position A, when tipped up on *one corner*, will serve for illustration. The *width* of the elevation is the diameter of the circle containing the octagon.

An *auxiliary or helping* plan must first be obtained. If the elevation A were set upright on *xy*, as is the first elevation in IV., its corresponding plan might be obtained as shown in II., A, and the problem finished as in IV. But it is unnecessary to repeat the elevation given. Turn the paper round and consider IL as the ground-line, draw projectors at right angles to IL, fix *o* as centre and draw the circle—on which the projectors will mark points 1 to 8. Join the points to form the octagon. This is the auxiliary plan, by the help of which the required plan can be drawn.

Every point in the auxiliary plan must be transferred to the new plan by measuring the distance from IL of the one, and marking the same distance from *xy* to fix the other. Take one point first as an example. From 5, the top corner of the elevation, draw a projector perpendicular to *xy*. Measure *ab*, the distance of 5 in the auxiliary plan from IL, and transfer it to *cd*, marking *d* as point 5 in the new plan. Next draw a projector from *e* (4 and 6). Mark on this projector two points, *lm* and *ln*, taken from *f*

GLYCERIN AS A BACTERICIDE.—Recent experiments of Dr. Copeman appear to show that all saprophytic and many pathogenic organisms are destroyed in the presence of glycerin in a space of time varying from three or four days to the same number of weeks. For sixty-seven days the diplococcus of Fränkel preserved its virulence in glycerin. The bacillus of fowl cholera was killed by four months' contact with glycerin. The virulence of anthrax gradually decreased, ceasing on the seventh day in one experiment, and on the ninth in another. Dr. Copeman advocates the addition of glycerin to lymph, claiming for the mixture that it dries up less readily than ordinary lymph, retains its properties unimpaired, and in process of time increases in potency.

***

COIN PICTURES.—A new method of taking impressions of coins and medals has been lately devised by Mr. F. Smith, the Millard Lecturer in Mechanics at Trinity College, Oxford. The coin or medal forms one plate, or coating, of an electrical condenser, and a photographic plate, or sheet of bromide paper, is placed between the two coatings, which are connected with the poles of an induction coil. The chemical surface of the dry plate is altered by the rapid charge and discharge of the plate for a fraction of a second. When developed, the plate shows a picture of the coin or medal. Mr. Smith finds that the best results are obtained by conducting the process in an atmosphere of oxygen gas. J. R. G.

TEACHERS' DRAWING LESSONS.

SOLID GEOMETRY OR PROJECTION.

STANDARD VII.

BY E. BUFFERY RIDGE,
Art Master under the London School Board.

Use the letters x, y, to indicate ground line.

I. Draw three plans of a hexagonal prism standing on end (3″ long, sides of hexagons 1″), and from them obtain three elevations.

In each case draw a circle, with radius 1″. In A draw a diameter *ab* parallel to *xy*, and mark the radius from *a* at *c* and *d*, and from *b* at *e* and *f*. This gives the six corners of the plan.

In B draw *ab* at right angles to *xy*, and in C draw *ab* neither parallel to nor at right angles to *xy*. Finish the plans B and C in the same manner as at A. Draw projectors perpendicular to *xy* for the elevations, and make the height above *xy* 3″.

Compare the three elevations. A shows four upright edges, derived from *a*, *d*, *f*, *b*. Two others, from *c* and *e*, would be dotted lines, but are covered by the front edges *d* and *f*.

B shows three upright edges from *f*, *b*, and *e*, which hide the other three.

C shows all the six; two of them, *a* and *d*, being at the back of the solid figure, are dotted lines.

II. From elevations similar to those at A and B (I.) obtain the plans. The size of the hexagonal ends is not given.

A. Draw projectors from the elevation, and a centre line. Fix any point on the centre line for the centre *o*. Draw *ab* parallel to *xy*. As the elevation shows the extreme width of the figure, *ab* will be the diameter of the circle required. Draw it, and join the points in which it cuts the projectors.

Refer to I. and note that the width in elevation is not equal to the diameter of the circle in the plan. To obtain the radius fix a centre *o*, and with the set square make an angle at *o* of 60°. This will give *oa* and *a*. On one of the projectors is one of the corners of the hexagon. With radius *oa* draw the circle, which will show the other five corners on the projectors.

C. To obtain the plan from the elevation in C (I.). In this case the size of the hexagon must be given, or the problem becomes too difficult for the class.

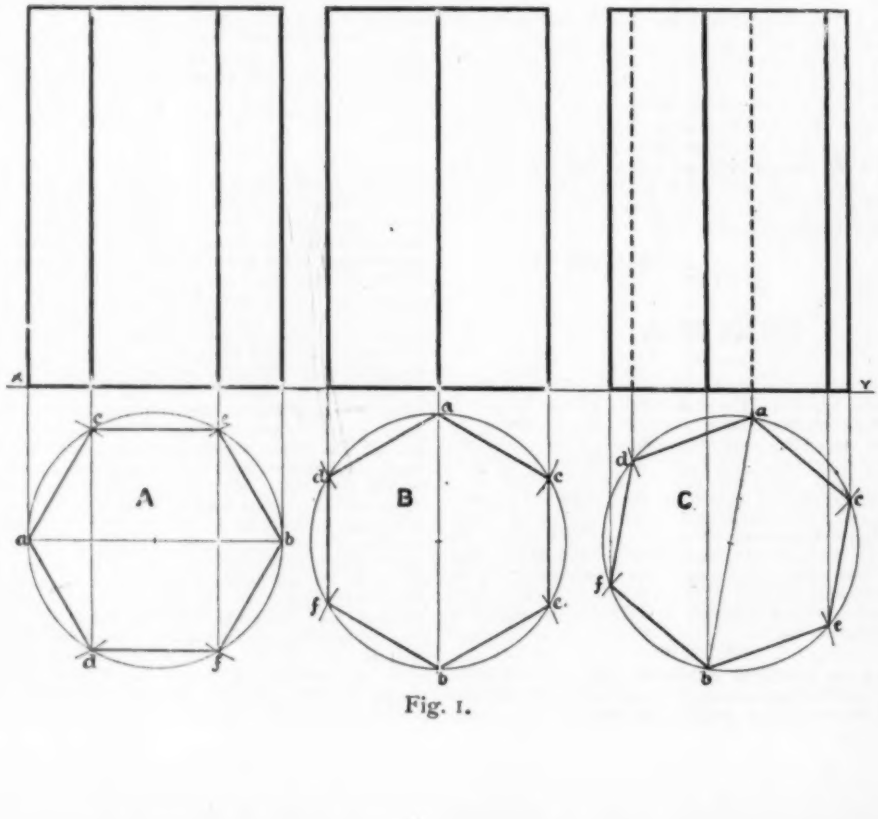


Fig. 1.

Fix a centre *o*, and with the given radius draw the circle, cutting the six projectors in the six required points.

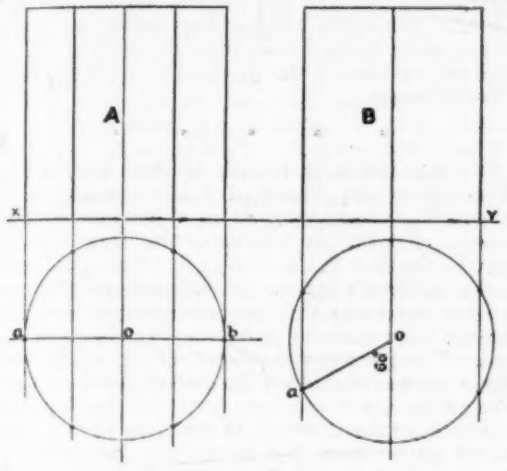


Fig. 2.

III. Hexagonal prism, tilted so that the base is inclined 60° to the horizontal plane, and the long edges are parallel to the vertical plane. Length, $2\frac{3}{4}$"; sides of hexagon, 1".

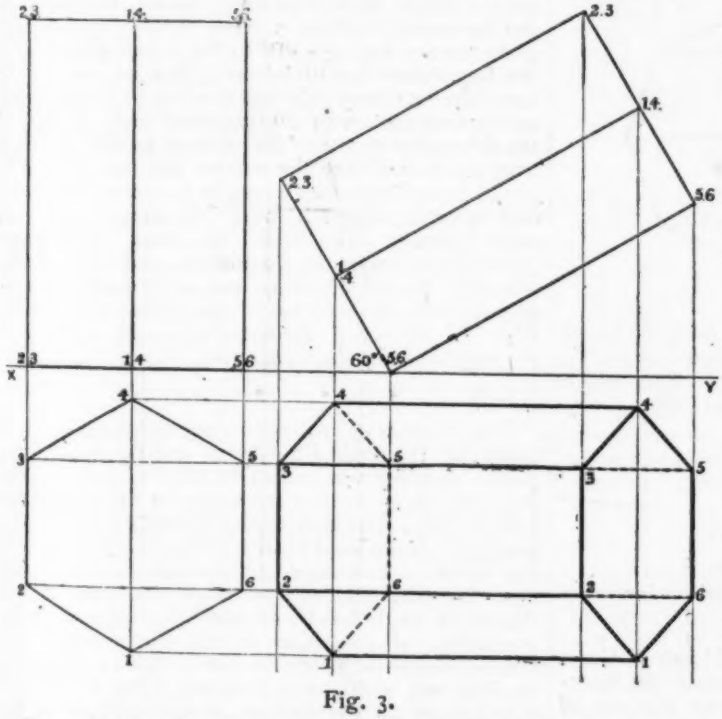


Fig. 3.

Draw first a plan and elevation similar to I., B. Copy the elevation by drawing the base at 45° to *xy*, and making the long edges at right angles to the base. Take exact measurements from the first elevation to get the second. In the first the solid stands upright on the ground: in the second it is tilted at an angle of 45°, but the shape and size are in no way altered.

Before proceeding with the second plan it must be understood, and seen by reference to the model, that tipping up the figure in a direction parallel to the vertical plane makes no alteration in the dimensions of the plan at right angles to *xy*; *i.e.*, the lines 2—3, 1—4, and 5—6 remain of the same length as before.

The numbers 1 to 6 in the plan are used in elevation for both hexagonal ends of the prism.

To obtain the second plan.—Keep in mind that there will be two hexagons shown, and take the top first. Draw a projector downwards from 5—6, and from 5—6 in the first plan draw parallels to meet the projector in two points, which will be 5—6 in the new plan. Draw a similar projector from 1—4, and parallels from 1—4 in the old plan to meet this projector, and mark 1—4 in the new plan. Get 2—3 in the same way. These six points joined by straight lines will give a hexagonal figure—the plan of the upper end of the prism.

For the lower end the work is precisely similar, the same parallels being used. In joining the points be careful to make the lines meeting at 5 and 6 dotted. These two corners rest on the ground; they are the lowest parts of the figure, and will be out of sight when the solid is viewed from above.

Join 4—4, 3—3, 2—2, and 1—1 by thick lines, and 5—5, and 6—6 by dotted lines. Part of the dotted lines will probably be covered and hidden by the thick lines.

Notice again that all the distances measured downwards from *xy* correspond in the two plans.

IV. A is the elevation of an octagonal prism, resting with one *corner* on the ground. Draw the plan.

The hexagonal prism in I., position A, when tipped up on *one corner*, will serve for illustration. The *width* of the elevation is the diameter of the circle containing the octagon.

An *auxiliary or helping* plan must first be obtained. If the elevation A were set upright on *xy*, as is the first elevation in IV., its corresponding plan might be obtained as shown in II., A, and the problem finished as in IV. But it is unnecessary to repeat the elevation given. Turn the paper round and consider IL as the ground-line, draw projectors at right angles to IL, fix *o* as centre and draw the circle—on which the projectors will mark points 1 to 8. Join the points to form the octagon. This is the auxiliary plan, by the help of which the required plan can be drawn.

Every point in the auxiliary plan must be transferred to the new plan by measuring the distance from IL of the one, and marking the same distance from *xy* to fix the other. Take one point first as an example. From 5, the top corner of the elevation, draw a projector perpendicular to *xy*. Measure *ab*, the distance of 5 in the auxiliary plan from IL, and transfer it to *cd*, marking *d* as point 5 in the new plan. Next draw a projector from *e* (4 and 6). Mark on this projector two points, *lm* and *ln*, taken from *cf*

and *eg*. Continue this process till the upper end of the elevation is shown in the new plan as a flattened

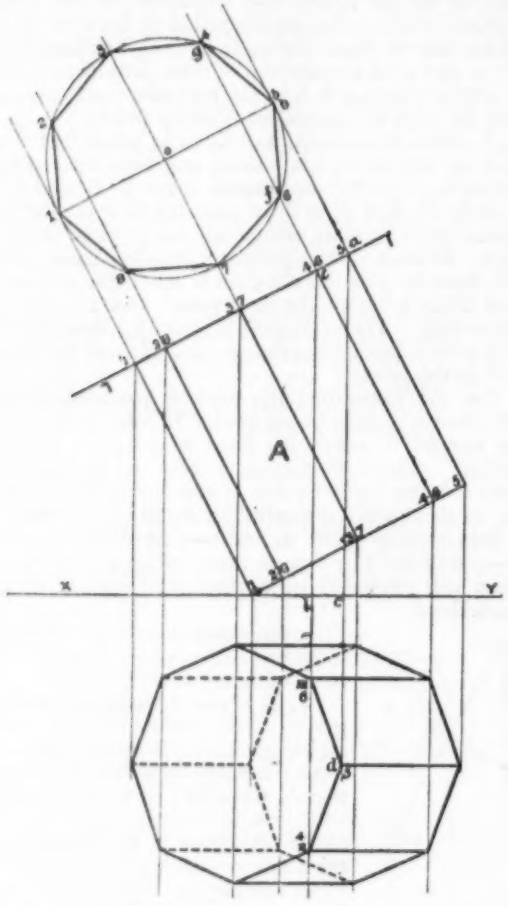


Fig. 4.

octagon then obtain a similar figure from the lower end. The problem can then be completed as in IV., great care being taken to indicate all edges which could not be seen from above by dotted lines.

NOTES AND NOTIONS.

BY RICHARD WADDINGTON,
Ex-President of the Half-Time Council of Teachers.

MR. ACLAND has announced in the House of Commons that the Government is considering the question of Security of Tenure. That any Minister of Education could tolerate a continuance of such scandals as Arlington, St. Stythians, and Wimblington, is impossible. From the anxiety of the teachers it is safe to say that only a very small fraction of the cases receive publicity.

> 'What's done we partly may compute,
> But know not what's resisted.'

The case is too acute to admit of procrastination. Year in, year out, the teacher has been subject to the caprice of the small School Board or the almost ubiquitous manager. Irrespective of the educational welfare of the district the efficient teacher has been evicted. Often the teacher has borne the trouble silently lest a worse befall, since so much of the professional welfare of the pedagogue is in the hands of the manager.

* * * * *

BUT the teacher in the Isle of Man has the right of appeal to the Board of Education, and in the town of Castletown there is an object lesson for Mr. Acland. Prior to the passing of the Free Education Act the teachers at Castletown had been paid partly by the children's pence. Immediately the Act came in force the same little re-arrangement was made that has been made in hundreds of schools in England. The teacher was offered a fixed salary, which was a serious reduction on that of previous years. Two of the three teachers accepted, but the third stood out for the average of previous years. Now, let me quote from the speech of Mr. Martin, a member of the School Committee that resigned because the Board of Education took the side of the teacher. He said :—'Each of the teachers held their position subject to three months' notice being given on either side, and the Committee, acting within their rights, after duly considering the matter in dispute, thought there was every reason to terminate the agreement, and so a three months' notice was given for the engagement to be terminated. Now, the Legislature has appointed it that no removal or appointment of any principal teacher shall take place unless first subject to the approval and sanction of the Education Board. An intimation was received from the Board that the matter was not strictly in order, being somewhat wrong in its technical details, and in order to put it more into shape it was put more formally. The Board was then asked to approve the action of the Committee, and after a considerable period of delay, and a good deal of correspondence, the outcome of the matter was that the Board of Education did not express its approval of the step taken by the Committee.

* * * * *

THE Committee resigned—not the teacher as is usual in 'the land of the brave and the free,' and a public meeting was called to endorse their action. A resolution approving the action of the Committee was moved and seconded, and then Mr. John Taylor, president of the local branch of the N.U.T., came on the scene. The case of the teacher was a good one, but Mr. Taylor marshalled his facts so well that not a single hand was held up in support of the resolution of confidence in the Committee. The Union is indebted to Mr. Taylor for his courage, pertinacity, and ability, and I offer him my hearty congratulations on the success of his defence of the teacher. When will this be possible in England, Mr. Acland?

* * * * *

AROUND Bolton it is customary to set one Sunday a year aside for the 'School Sermons.' It is somewhat of a red-letter day, or, more appropriately, 'white-letter day,' since the little girls are dressed

in white, and large sums are collected for school expenses, ranging from £50 to £300. Many of you will have heard the story of the man who was discovered sitting in the hedge on a wet Saturday night, and who, on being accosted by a friend, said, 'Houd th' noise, it's our sermons i' t' morn, and I'm getting ready to sing bass.' But as I was walking through a village outside Bolton the other Sunday evening I met two happy-looking gentlemen carrying the collection money through the village. The bag was fastened to a walking stick, which was used as a pole, and reminded me of Joshua's two faithful spies returning from the Promised Land laden with fruit.

* * * * *

THE stringing-up process with the Drawing is likely to lead to unpleasant results. There would appear to be little doubt that the word has gone forth to endeavour to force classification by age. The instruction that no child over eight years of age in the first standard, and no child over nine in the second standard is to receive a higher mark than 'Good,' is a direct breach of faith. In reply to the deputation from the N. U. T. on March 5th, 1892, Sir William Hart Dyke said:—'It is the intention of the Department that there should be absolute freedom of classification in regard to Drawing, and I have only to say that if the rules and regulations do not bring about that result, I for one can promise that we shall be most glad to consider them.' And again, on the same occasion, when pressed by Mr. Wild, he said:—'I have not the least reservation with regard to that; and if our present regulations do not carry that out, they shall be amended so as to secure it.' And not less emphatic was the statement of the Secretary to the Science and Art Department on another occasion.

* * * * *

THE Alternative Course in Arithmetic in the New Code means a good deal more than appears at first sight. There seemed a possibility of the fourth and higher standards being unduly loaded. With a view to elucidating this point, I wrote to the Department asking the following questions:—

'1. Does "reduction and compound rules applied to the following weights and measures for Standard IV." mean that the four rules must be mastered in addition to reduction; *i.e.*, would the following be within the requirements: 15 tons 13 cwts. 3 qrs. 11 lbs. ÷ 27?

'2. And in the fifth standard does common weights and measures include such problems as 3 acres 2 rds. 15 ps. 27¼ sq. yds. ÷ 137?'

The answer is—

'Adverting to your letter dated the 7th inst., I am directed to inform you, in reply to your first inquiry, that the sum "15 tons 13 cwts. 3 qrs. 11 lbs. ÷ 27" would be within the requirements under the present Code for Boys and Girls in Standard IV. In reply to your second inquiry, the sum "3 acres 2 rds. 15 pls. 27¼ sq. yds. ÷ 137" would be within the requirements for Boys, but not for Girls.'

And this means that the fourth standard is very much overweighted. But the fifth standard is still more unfairly treated. It is to be regretted that so educational a syllabus for the lower standards is made to press so hardly on the upper standards.

* * * * *

IF the complaints are in any measure an index of the failure of the enforcement of the Compulsory Attendance at school, then irregularity increases day by day. From north, south, east, and west the cry of desperation is borne. When will the Education Department awake to its obligations? Between the inefficiency of the Local Authorities and the indifference of the Magistracy, the thriftless and careless parent is allowed to perpetuate his race. Without more active interference on the part of the Department, the desired improvement is past hoping for. Free Education has failed to improve the attendance. Wherein lies the cure? The problem is not an easy one; but without a much stronger administration of the law, the irregulars will increase. Much might be done to improve the administration by the appointment of Special Inspectors of Attendance, who should have the power to initiate prosecution if necessary. The matter is becoming more important day by day. Managers are anxious, since so much of the income of the school now depends on the average attendance; and the nation is concerned that the money spent on education shall not be frittered away by the gross negligence of indifferent parents. The medical man who would find a cure for Monday morning and Friday afternoon sickness would be a national benefactor.

* * * * *

I HAVE before me a school circular which contains the following:—

'In conclusion, let me point out some of the special features of the school. It is the day school in ————, at which boys and girls are taught shorthand. *Further, Standard I. read and are examined from a Standard II. reading book; also Standard III. read and are examined from a Standard IV reading book.*'

And this circular bears the name of the head master. What next? I only sorrowfully repeat the words of Proverbs xxvii. 22.

* * * * *

THE contest for the Vice-presidency of the N. U. T. is likely to be a keen one. So far Mr. Ellery alone appears in the field, but ere long I anticipate he will find a foeman worthy of his steel in Mr. Macnamara. The admirable way in which my predecessor in these columns has ventilated the wrongs of the oppressed in the columns of 'The Schoolmaster' has done much to redeem the promise made to the Executive on his appointment, that he would endeavour to make the paper a living commission for ventilating the grievances and bettering the position of the teachers throughout the country. The contest will be interesting and good humoured, and I wish them both success.

* * * * *

THE question of the Federation of Assistants is to come up at the Annual Conference of Assistants at Derby. I understand the sub-committee has drafted a scheme for presentation to the Conference. Federation is the right line for assistants—about that, as a strong Unionist, I have no doubt, but it should be federation of the assistants in the N. U. T. The federation of the teachers in half-time and rural districts has done much to aid the work of the Union, and a similar focussing of the views and demands of assistants will strengthen the N. U. T. At present the various Assistants' Associations throughout the country are composed of Unionists and non-Unionists. To bring about a scheme of federation membership of the N. U. T. should be a

sine quâ non, as it is in the Half-time Council. I can understand that the leaders of the assistants fear the imposition of this condition in the initial stages of their scheme, but they will make a huge and irretrievable mistake if they do not grasp the nettle once for all. Take the work of the Union during the last few months on corporal punishment, and tell me where is the assistant who refuses his subscription to the N. U. T., and I will show you the man it is idle to federate.

'A stoic of the woods,—a man without a tear.'

* * * * *

THE results of the May Examinations of the Science and Art Department are, so far, surpassing all record in the paucity of successes. There is only one redeeming feature in this, and that is in the possibility of the public mind being aroused to a true sense of the iniquity of the present method of encouraging scientific instruction. The eccentricities of the authorities at South Kensington are proverbial, and in any country but England would hardly have been tolerated so long.

* * * * *

THE Union is determined to keep the question of Superannuation to the fore. The next step is a deputation to the Chancellor of the Exchequer. Effort is to be made to ensure a gigantic deputation of members of Parliament. From what transpired during the debate on the Superannuation resolution, there ought to be no difficulty in securing the support of a large array of members. The Chancellor of the Exchequer is the one obstacle in the way of the carrying out the resolution of the House. I am sure nothing would give Mr. Acland greater pleasure than the passage of a reasonable scheme during his stay at Whitehall. A successful deputation might do much to make this possible. May I appeal to my readers to ensure the presence of the member for their division? Don't leave it to officials, but write individually. If every teacher in the country writes to the local M.P., the effect would be to bring Superannuation within measurable distance of solution. Is there a teacher who will say 'No?'

ELEMENTARY LESSONS IN HORTICULTURE.

BY PROFESSOR J. R. GREEN, M.A.,
Examiner in Botany to the University of Cambridge, and

F. L. GREEN,
Late Science Mistress in the Clifton High School.

IV.—FOLIAGE LEAVES AND THEIR FUNCTIONS.

WE have seen, in our consideration of the stem, that leaves are out-growths of the shoot-axis, the node, or point from which a leaf is given off, the epidermis or outer covering of the shoot-axis, and the cortical tissue all being continued into the leaf. Leaf structures, or *phyllomes*, may be distinguished into four classes—foliage leaves, possessing a well-developed lamina, or blade; scales, or cataphyllary leaves, the sheaths of leaves whose petioles and blades are undeveloped; bracts, and flower-leaves. It is with the first of these four classes that we are now concerned.

A foliage leaf usually presents the appearance of a horizontally flattened broad surface, which can generally be divided by a perpendicular plane into two symmetrical halves. A good example will be found in an ivy leaf. Sometimes the halves of the leaf are dissimilar, as in the elm or begonia. The leaf is then said to be unsymmetrical. Sometimes the ordinary flattened form of the leaf is departed from, as in the needle-like or *acicular* leaves of the fir, the *cylindrical* leaves of some species of stone-crop, and the *tubular* leaves of garlic. In many leaves three parts are found, as in the parsley—the *sheath*, enclosing the stem at the insertion of the leaf, the leaf-stalk, or *petiole*, and the *lamina*, or blade. Other leaves, *e.g.* those of the garden nasturtium, have only petiole and blade, while in the grasses only sheath and blade occur. Frequently, as in the lily, the leaf is *sessile*, only the blade being present.

The duration of leaves as compared with that of the stem must be regarded as transient. They may last only for a single season, when they are termed *deciduous*, as in herbaceous plants and most forest trees. They may remain through the winter season till after the appearance of new leaves, so that the stem is never without leaves, as in *evergreens*. In most evergreens the leaves have in reality only an annual duration, the old leaves falling off soon after those of the new season are expanded. Pines and firs form an exception to this rule. They are subject, indeed, to an annual fall of leaves either in autumn or spring, but these leaves are the survival of earlier seasons, the branches being continually clothed with the foliage of from two to five, or, in some cases, as many as ten years. We shall see, in discussing the functions of foliage leaves, that it is essential that leaves should only be of transient duration, at least in their active condition.

Passing now to consider the structure of the leaf, we shall find that the external form which we have examined is associated with a very peculiar construction of the various parts of the interior, both alike being adaptations to enable the leaf adequately to do its part in the nutritive processes of the plant. Before examining it in detail, we will notice again particularly the broad expanded surface, very great indeed in comparison with its thickness, so that as much as possible of the leaf substance is brought into contact with the air. This is important for two reasons—the air contains a valuable, indeed an essential part of the plant's food, and it allows a copious evaporation of the water which the roots absorb. Both these so-called *functions* of the leaf are essential to its life and growth.

We notice, again, the way the leaves are attached to the stem—usually by a flexible stalk, which can allow the blade to shake about when exposed to the wind. This is important in connection with the freedom of evaporation. The stalk, or petiole, allowing movement of the blade, enables the leaf to take up a particular position with regard to the rays of sunlight. We noticed that the stem showed a power of responding to these, in taking up its own

position; the *irritability* of the stem, as we called it, is shared by the leaf, though it is manifested in a different way, which causes the position of the leaf to be one at right angles to the sun's rays.

Not only is the movement of the leaf allowed to take place by the peculiar mode of attachment we see, but the flexibility of the petiole prevents the leaves from being stripped off by storms and wind. The veins in the leaves are also calculated to preserve the thin blade from being torn. As we shall see, the cells of the blade of the leaf are usually very thin and delicate, and not calculated to resist much outward disturbance. Running all through the leaf, however, are the so-called veins, which are really fibrovascular bundles, and these aid in maintaining the leaf intact, as well as ensuring the flat expanded condition. Leaves vary very much in the arrangement of these veins. Some form a close network, the meshes of the net being very closely set together at the lateral margins, where they form really a series of arches supporting each other. Others have a number of strong veins running parallel to each other along the whole length of the leaf, and being connected together by thin delicate veins, usually at right angles to the others. Thus, apart from the work the fibrovascular bundles do, their arrangement is very important from a merely mechanical point of view.

What, now, is the interior of a leaf like? The petiole need not detain us long; it is something like the stem, having an epidermis, surrounding a mass of ground or fundamental tissue, and containing some fibrovascular bundles. Generally there are but few of these, and they are not disposed in a circle, as in the stem. They occupy the central part of the section of the stalk, but their wood is always towards the upper side, and their bast is always towards the under. A petiole is said thus to have dorsiventral symmetry, because there is an upper and a lower surface which are different from each other. A stem is said to have radial symmetry, in contradistinction to this. There is another important difference noticeable between the fibrovascular bundles of the stem and petiole. The latter do not contain any of the tissue called *cambium*, to the presence and activity of which all secondary increase in thickness of the stem is due.

If you cut a section of a leaf, almost the first thing that will strike you is the thinness of the walls of the cells which it is composed of. Unlike stems, the tissue of leaves does not thicken very much, with the exception of some of the walls of the outer layers. The cells have very delicate walls, which are composed of cellulose, and which allow of a very ready passage of fluid from cell to cell. The living substance, or protoplasm, of the cells does not fill them, but is arranged more or less completely round the walls, forming the so-called primordial utricle. There is thus a very large cavity or vacuole in each, which is filled with water, in which is dissolved a variety of substances generally connected with the work which the leaf has to do in the nutritive processes of the plant. Another point about the cells is that most of them contain little granules of green colour embedded in their living substance—a material of the highest importance, because it is by its assistance that the feeding which the leaf is carrying on is effected.

Let us now see how the various cells and tissues are disposed, and try to get some idea why they are placed as they are. If we take a thin vertical section and put it under a high power of the microscope we shall find it is built up in the following order from above downwards:—(1) an upper epidermis; (2) a row or several rows of elongated cells placed side by side without any spaces between them; (3) a layer of irregularly shaped cells, loosely arranged, with a large number of inter-cellular spaces; (4) a lower epidermis. Between (2) and (3) we shall come across sections of the veins or fibrovascular bundles.

Each of these layers should be studied separately. The upper epidermis is made up of cells which on the surface are often very irregular in shape, sometimes having a very sinuous outline. In section they look brickshaped, and have their outer edges much thickened. The thickening has been applied to the original wall by the protoplasm within, and often the successive layers can be traced. At first these are all cellulose, but as the epidermis gets older the outer ones become changed into a substance known as cutin. When this has been effected, very often large pieces of the exterior can be detached in the form of the so-called cuticle, which is really a sheet made up of the outer layers of the cell walls of these epidermal cells. The walls split in fact at the depth to which the change of chemical substance has penetrated. This change is often spoken of as cuticularisation, and it is protective in its character.

The cells of the epidermis do not contain chlorophyll, the green colouring matter alluded to, but are filled generally with water. Some plants store up a good deal of water here, the epidermis being a sort of reservoir.

In some plants the upper epidermis is like the lower in containing some curious bodies called *stomata*, which we shall describe presently. A great number of plants, however, only have these in the lower surface.

The upper epidermis and the lower both alike often have a clothing of hairs, which are outgrowths from their cells. These are often fine and delicate; often long and interlacing. They are protective in character, the air which the interlacing feltwork holds in its meshes helping to do away with the loss of heat by radiation, which is often fatal to many growing leaves. Some plants, like the so-called ice-plant, have large bladder-like hairs on the leaves, which help to serve as a reservoir for water.

The second layer in order, composed of cells ranged side by side, a good deal longer than broad, is known as the *pallisade* layer, or the pallisade parenchyma. It is here that the chlorophyll or green colouring matter is present in largest amount. The microscope will show little yellow granules shedding the protoplasm which lines the cell walls. These grains are never to be found floating freely in the cavity of the cell, but always embedded in the protoplasm. Each little grain consists of a sort of spongework, which is itself protoplasmic in nature, and which is permeated by the green colouring matter. The latter can be extracted by soaking the leaf, or the section, in alcohol, in which it dissolves. The little protoplasmic body, sometimes called a *chloroplast*, then

remains much to look at as before, except that it is colourless.

The close arrangement of the pallisade cells, and the way the chloroplasts are arranged in them, makes the upper surface of the leaf usually of a darker green than the lower one, where the cells are not so close together.

The third layer is known as the *spongy parenchyma*, because it is full of intercellular passages, which in some leaves take up more room than the cells themselves. The cells are generally round or oval in section, but may be very irregular. They do not touch each other at all points, but form between them a system of loose channels or passages, which are filled in life with air charged to saturation with the vapour of water. At particular places under the lower epidermis these intercellular spaces form a sort of chamber or vestibule which is just under a peculiar aperture which we have already referred to under the name of *stoma* (*pl. stomata*).

The lower epidermis is a good deal like the upper, except for the stomata. Its cuticle is not so thick, and often its cells are not quite so large, but the differences are small.

Now what is a *stoma?* It is really a little slit or crack between certain cells of the epidermis, and it opens into the large intercellular space we have already spoken of. The slit is between two curious cells, known as guard-cells, because they can open or close the aperture. The guard-cells are somewhat sausage-shaped, and are attached to each other by thin ends only. When they are full of water they swell out and so cause the opening between them to gape. When they have little water in they shrink together, almost collapsing, and their lateral walls come into contact and close the stoma. Whether the stomata are open or shut then will depend on the quantity of water the guard-cells contain, or, as botanists phrase it, on the turgidity of the guard-cells.

This is very important because upon their action depends very much the quantity of water which the plant gives off from time to time. We shall presently try to ascertain a little more about their function in connection with the process called transpiration. Meantime we may note another point about them—the guard-cells contain chlorophyll, differing in this respect from the other epidermal cells.

The fibrovascular bundles are more delicate in structure in the leaf than they are in the stem or the petiole. We have seen that as they bend out towards the petiole the wood part is uppermost, while the bast lies towards the under surface. This is the same in the leaf; the wood lies nearest to the upper side. Both wood and bast are much reduced; the vessels are no longer open all through, but the cells of which they are constructed retain their end walls, forming a collection of so-called *tracheids*. They show the same kind of markings or irregular thickenings that they do in the stem. The bast shows similar modifications, ultimately appearing as only elongated thin walled cells with rich protoplasmic contents. The wood and bast are in close contact with the pallisade and spongy mesophyll respectively.

Now what is all this very elaborate structure for? What does the leaf do in the economy of the plant? First and foremost it is the organ by which nearly all the carbon of the plant is absorbed. It is concerned, that is, in the feeding of the plant. The carbon is derived from the air, in which it is found in the form of a colourless gas, known as carbon dioxide, or CO_2. When a careful analysis of pure air is made, it is found to consist of about 79 parts of nitrogen and 21 parts of oxygen, with 4 parts in 10,000 of this carbon dioxide. Scarcely an appreciable quantity compared with the oxygen and nitrogen—and yet it is this trifling amount which is the supply of all organic material. Only plants containing chlorophyll are able to use this faint trace, and to the action of the plant is therefore due all the formation of organic substance found in nature. We can now see why there is developed such an enormous surface of leaf substance. The greater the surface, the more easily is this trace of carbon dioxide picked out of the surrounding atmosphere. The way the leaf absorbs it is a purely physical process. CO_2 is soluble in water—the surface of the epidermal cells is saturated with water, and in this the gas dissolves and diffuses inwards with the fluid in the cells. From the epidermal cells it diffuses again into the cells containing the chlorophyll corpuscles, or chloroplasts. It used to be thought that the gas made its way into the interior of the leaf by means of the stomata, which were held to be little mouths for the purpose of feeding. This has, however, been found to be erroneous; some air may enter the stomata when they happen to be open, but as CO_2 is absorbed also when they are closed, they evidently are not chiefly concerned in the absorption. We shall see presently that they play another part altogether in the leaf's work.

Reaching in the way described the chloroplast, we find that these little structures are capable of decomposing the CO_2. They can only do this in the presence of sunlight, and, speaking broadly, we may say that the more intense the light, the better they can work. Carbon dioxide is a very difficult body to split up. Indeed, in our laboratories it can only be done at very high temperatures and under special conditions. It is evident, then, that a good deal of work must be done in decomposing it, or, in other words, a good deal of energy must be expended on it. Where does the leaf get this energy from? It is found that chlorophyll can absorb certain of the rays of sunlight, particularly some of the red and yellow ones. It is the energy of these rays that does the work. The carbon dioxide is split up into carbon monoxide (CO) and oxygen. At the same time some of the water is decomposed, hydrogen and oxygen being liberated from it. The oxygen from both escapes into the air, while the two residues, carbon monoxide and hydrogen, unite to form a body known as formic aldehyde. From this some form of sugar is elaborated, and, again, from this starch is produced. Thus the first visible sign of the activity of the leaf in feeding is the appearance of minute grains of starch, which are to be seen in the interior of the chlorophyll grain. Their subsequent fate depends upon what the plant is doing at the time. If growth is proceeding vigorously, this starch is converted into sugar and transported to the growing fruits. If the plant is forming its seeds, a quantity of the sugar is directed to these, and is there re-

transformed into starch and stored up for the future use of the seed, travelling in either case along the bast of the fibrovascular bundles. We thus see why the bast is arranged in such close contact with the parenchyma of the leaf.

But another very important function which the leaves perform is the absorption of water from the soil and its passage through the plant. We have seen that the root absorbs the water with a good deal of eagerness, and forces it upwards into the stem. The stream of water is, however, only partially due to the action of the root. All the delicate tissues are charged with this water, and a copious evaporation takes place from the cells into the intercellular spaces. These form a system of channels throughout the whole plant, those of the stem communicating with those of the leaves. We have seen that the lower sides of the leaves are very liberally furnished with these intercellular spaces, and we can now realise that the air in them must be charged with the vapour of the water. The walls of the cells which abut on the spaces are very thin, and evaporation readily takes place. Now it is found that a leaf is continually giving off water. If we take a branch and put it into a closed glass vessel, such as a stoppered bottle, very soon the sides of the vessel will be covered with a fine dew, while the leaves will be seen to become flaccid and to droop. This is technically known as withering, and is due to the loss of water from the cells. If a cut flower be laid aside in the air it speedily withers. If its end be inserted into a vessel of water, it retains its freshness for a longer time, but eventually the withering can be observed. The longer time that takes place is due to a certain amount of absorption of the water taking place at the cut end. It only lasts a comparatively short time, as the wound soon ceases to be capable of absorbing the water. The water in the intact leaf ascends into it by the *wood* of the fibrovascular bundles, and thence passes into the cells of the mesophyll, evaporating from these into the intercellular spaces. The cuticularised surfaces of the two epidermal layers help very greatly to check evaporation from the leaf. A young delicate leaf will wither much sooner than an older one whose cuticle is well formed. It is necessary, however, that the water shall pass off fairly rapidly, as we have seen that a good stream through the plant is necessary for the absorption of an adequate supply of mineral matter from the soil. In this regulation of evaporation, or transpiration, we have the true explanation of the structures we have called stomata. When water is abundant in the leaf's cells, the guard-cells of the stomata share in it, and, becoming turgid, they open, and the air from the intercellular spaces, saturated with moisture, escapes. When there is but little water in the leaf, the stomata guard-cells becoming flaccid, close the openings, and the water is economised. The guard-cells absorb their water from the neighbouring cells, and do not use the watery vapour which has already evaporated into the intercellular spaces.

Thus the leaves play a very important part indirectly, in causing or helping the absorption of food materials from the soil. The importance of this function can be seen by comparing a tree such as an elm, where there is an enormous leaf surface, with a plant which has but little surface compared with bulk, such as a cactus. The greater development of the former is correlated with the large stream of water containing nutritive materials drawn from the soil.

The evaporation of water from the leaves is sometimes associated with other structures in the leaves to help the process. In a great many plants special bodies called water glands may be found in the leaves, generally opening on the edges or at the tips. The best example of these is perhaps *Saxifraga incurstata*, where the water glands are very elaborate bodies found at the ends of the fibrovascular bundles in the leaves. The balsams also show similar mechanisms. It is easy to see them with drops of water at the edges of the leaves, excreted by somewhat similar arrangements. Many grasses show the same thing.

The leaf can be shown to have a third function—that of respiration. Wherever there is living substance, there must be a supply of oxygen for breathing. It is just as necessary for a plant as for an animal. Respiration consists in the absorption of oxygen and the giving off of carbon dioxide. Now, so long as a leaf is living it must be doing this. It is not very easy to prove that this is always going on, as the process is masked or hidden in the daylight by the process of feeding, which consists in the absorption of carbon dioxide and the giving off of oxygen. Still it can be demonstrated by appropriate methods. This process then is constant during the life of the leaf; not intermittent, as is the feeding. It can be shown quite readily in darkness, when the converse process is in abeyance. In years gone by botanists taught that a plant absorbed CO_2 by day and gave it off by night, and hence that it was very injudicious to have plants in bedrooms at night. In more recent times, the true course of events has been ascertained, and we know that respiration and assimilation go on side by side during the day, the latter ceasing as soon as daylight fails.

Foliage leaves, like shoot axes, occasionally assume considerably modified forms. Leaflets may be modified into tendrils, as in the sweet pea, while occasionally, as in the barberry, the lamina becomes a spine. A curious instance of modification takes place in the case of insectivorous plants for the purpose of securing prey. In the round leaved species of sundew, stalked glands thickly beset the whole upper surface of the blade, and a small insect alighting on it is touched by all the glands within reaching distance, the blade incurving as a part of the general movement. In Venus's fly-trap, at the top of each leaf there is a two-valved body margined laterally with bristles. When any one of the sensitive hairs of the upper surface is touched, the trap suddenly closes, retaining the insect, which is macerated. In a pitcher plant, *Nepenthes*, the midrib of the simple leaf is continued beyond the apex of the lamina into a tendril terminating in a pitcher with a lid. We have seen in our consideration of the stem that bulb-scales, a good example of which is afforded by the onion, are modified leaves.

To recapitulate: We have seen that:—

(i.) Leaf structures, or phyllomes, are of four classes—foliage leaves, scales, bracts, and flower leaves. Foliage leaves may be deciduous or evergreen, but in every case they are of transient duration in their active condition.

(ii.) The broad expansion of a leaf's surface brings as much as possible of the leaf substance into contact with the air, which contains an important part of the plant's food, and also allows a copious evaporation of the water we have seen to be absorbed by the roots. The petiole is of service to the leaf by its flexibility preventing the leaves from being stripped off by the wind. The veins of the leaf also serve the purposes of support and protection.

(iii.) The petiole of a leaf is similar in structure to a stem, but does not contain cambium tissue. The blade, or lamina, consists of an outer and inner epidermis, and a layer of irregularly-shaped cells containing chlorophyll grains, which is called the mesophyll.

(iv.) Chlorophyll grains are found embedded in the protoplasm of the cells containing them. They consist of a sort of spongework permeated by green colouring matter.

(v.) Stomata, little slits or cracks, occur between certain cells of the epidermis called guard-cells, which contain chlorophyll. The function of the stomata is to regulate the exhalation of water in the process of transpiration.

(vi.) Carbon contained in the atmosphere is decomposed by the chlorophyll grains under the influence of sunlight, oxygen being set free, and a body known as formic aldehyde being formed, which results in the formation of some form of sugar, from which again starch is elaborated, which is used up in the further processes of nutrition.

(vii.) A leaf is continually giving off water, the process of transpiration being regulated by the stomata.

(viii.) Another function performed by the leaf is that of respiration, the absorption of oxygen and giving off of carbon dioxide, a process which is constant during the life of the leaf, occurring side by side with the process of assimilation during the day, and continuing in the dark when assimilation is in abeyance.

MODEL ANSWERS TO CERTIFICATE QUESTIONS.

MEN.

CHRISTMAS, 1892.

Algebra.

FIRST YEAR.

1. Find the value of—

(*a*) $\frac{\sqrt{m+n}+\sqrt{m-n}}{\sqrt{m+n}-\sqrt{m-n}}$ when $n=\frac{2mp}{p^2+1}$, and (*b*) prove that $-m=\frac{1}{am}$, (*c*) $a^0=1$.

(*a*) $$\frac{\sqrt{m+n}+\sqrt{m-n}}{\sqrt{m+n}-\sqrt{m-n}}$$

Rationalising denominator we get—

$$\frac{2m+2\sqrt{m^2-n^2}}{2n}$$

$$=\frac{m+\sqrt{m^2-n^2}}{n}$$

Substituting for n—

$$\frac{m+\sqrt{m^2-\frac{4m^2p^2}{p^4+2p+1}}}{\frac{2mp}{p^2+1}}$$

$$=\frac{m\left(1+\frac{p^2-1}{p^2+1}\right)}{\frac{2mp}{p^2+1}}$$

$$=\frac{2mp^2}{2mp}$$

$$=\underline{p}. \text{ Ans.}$$

Assuming that—

$$a^m\times a^n=a^{m+n}$$

(*b*) Similarly—

$$a^{-m}\times a^m=a^{-m+m}$$

$$=a^0$$

$$=1$$

$$\therefore a^{-m}=\underline{\frac{1}{a^m}} \text{ Ans.}$$

(*c*) Whatever values m and n may have—

$$a^0\times a^n=a^{0+n}$$

$$=a^n$$

$$\therefore a^0=\frac{a^n}{a^n}$$

$$=\underline{1}. \text{ Ans.}$$

2. Simplify—

(1) $$\frac{\frac{1}{a^2+ab+b^2}+\frac{1}{a^2-ab+b^2}}{\frac{2a^2-2b^2}{a^4+a^2b^2+b^4}}$$

(2) $$\frac{\sqrt{a^2+1}+\sqrt{a^2-1}}{\sqrt{a^2+1}-\sqrt{a^2-1}}+\frac{\sqrt{a^2+1}-\sqrt{a^2-1}}{\sqrt{a^2+1}+\sqrt{a^2-1}}$$

(1) $$\frac{\frac{1}{a^2+ab+b^2}+\frac{1}{a^2-ab+b^2}}{\frac{2a^2-2b^2}{a^4+a^2b^2+b^4}}$$

$$\frac{\frac{2(a^2+b^2)}{a^4+a^2b^2+b^4}}{\frac{2(a^2-b^2)}{a^4+a^2b^2+b^4}}$$

Now cancelling by $\frac{2}{a^4+a^2b^2+b^4}$ we have

$$=\underline{\frac{a^2+b^2}{a^2-b^2}} \text{ Ans.}$$

(2) $$\frac{\sqrt{a^2+1}+\sqrt{a^2-1}}{\sqrt{a^2+1}-\sqrt{a^2-1}}+\frac{\sqrt{a^2+1}-\sqrt{a^2+1}}{\sqrt{a^2+1}+\sqrt{a^2-1}}$$

$$\frac{a^2+1+a^2-1+2\sqrt{a^2+1}\sqrt{a^2-1}+a^2+1+a^2-1-2\sqrt{a^2+1}\sqrt{a^2-1}}{a^2+1-a^2+1}$$

$$=\frac{4a^2}{2}=\underline{2a^2} \text{ Ans.}$$

3. (*a*) Show that if a quantity measures both A and B, it will measure $mA\pm nB$.

(*b*) Find the G.C.M. of

$$6a^4+5a^3b-10a^2b^3+7ab^3-2b^4 \text{ and}$$
$$12a^5+7a^4b+3a^3b^2-4a^2b^3+5ab^4-$$

(*a*) Let x be the quantity which measures A and B.

Suppose $A=px$

$B=qx$

Then $mA \pm nB$
$= mpx \pm ngx$
$= x(mp \pm nq)$

$\therefore x$ measures $mA \pm nB$. Q. E. D.

(*b*) Greatest Common Measure. Taking the Coefficients. (Short Method.)

$6 + 5 - 10 + 7 - 2$ | $12 + 7 + 3 - 4 + 5 - 1$ | -2

$12 + 10 - 20 + 14 - 4$

$6 - 46 + 36 - 18 + 2$ | $-3 + 23 - 18 + 9 - 1$

$51 - 46 + 25 - 4$ | -51 | 17 | $\times$

$153 - 1173 + 918 - 459 + 51$ | 3

$153 - 138 + 75 - 12$

$-1035 + 843 - 447 + 51$ | -3 | $\div$

$345 - 281 + 149 - 17$ | 17

$5865 - 4777 + 2533 - 289$ | 115

$5865 - 5290 + 2875 - 460$

$513 - 342 + 171$ | 171 | $\div$

$3 - 2 + 1$

$51 - 34 + 17$ | -4

$-12 + 8 - 4$

$-12 + 8 - 4$

$3a^2 - 2ab + b^2$ Ans.

$2a$ | $\div$ | $3a$ | $\times$ | 115 | $\div$

$12a^4 + 7a^3b + 3a^2b^2 - 4a^1b^3 + 5a^0b^4 - b^5$

$12a^4 + 10a^3b - 20a^2b^2 + 14a^1b^3 - 4a^0b^4$

$-b) - 3a^3b + 23a^2b^2 - 18a^1b^3 + 9a^0b^4 - b^5$

51

$3a^4 - 23a^3b + 18a^2b^2 - 9a^1b^3 + b^4$

$153a^4 - 1173a^3b + 918a^2b^2 - 459a^1b^3 + 51b^4$

$153a^4 - 138a^3b + 75a^2b^2 - 12a^1b^3$

$-3b) - 1035a^3b^2 + 843a^2b^3 - 447a^1b^4 + 51b^5$

$345a^3 - 281a^2b^2 + 149a^1b^3 - 17b^4$

17

$5865a^3 - 4777a^2b^2 + 2533a^1b^3 - 289b^4$

$5865a^3 - 5290a^2b^2 + 2875a^1b^3 - 460b^4$

$171b) 513a^2b^2 - 342a^1b^3 + 171b^4$

Ans. $3a^2 - 2ab + b^2$

(Usual Method.)

$2a$ | $6a^4 + 5a^3b - 10a^2b^2 + 7a^1b^3 - 2b^4$

$6a^4 - 46a^3b + 36a^2b^2 - 18a^1b^3 + 2b^4$

$b) 51a^3b - 46a^2b^2 + 25a^1b^3 - 4b^4$

$51a^3 - 46a^2b + 25a^1b^2 - 4b^3$

$51a^3 - 34a^2b + 17a^1b^2$

$-12a^2b + 8a^1b^2 - 4b^3$

$-12a^2b + 8a^1b^2 - 4b^3$

$\div 17a$ | $-4b$

4. (*a*) Find a multiplier which will make a given Binomial surd such as $\sqrt{a} + \sqrt{b}$ rational.

Take the general case.

Suppose the surd be $\sqrt[p]{a} + \sqrt[q]{b}$.

Let $\sqrt[p]{a} = x$.

$\sqrt[q]{b} = y$.

And let n be the L.C.M. of p and q; then x^n and y^n are both rational.

(1) If n is even; $x^n - y^n$ is divisible by $x + y$.

And $x^n - y^n = (x + y)\left(x^{n-1} - x^{n-2}y + \ldots\ldots + xy^{n-2} - y^{n-1}\right)$

Thus the rationalising factor is—

$$\frac{x^{n-1} - x^{n-2}y + \ldots\ldots + xy^{n-2} - y^{n-1}}{}$$ Ans.

(2) If n is odd, $x^n + y^n$ is divisible by $x + y$.

And $x^n + y^n = (x + y)\left(x^{n-1} - x^{n-2}y + \ldots\ldots - xy^{n-2} + y^{n-1}\right)$

Thus the rationalising factor is—

$$\frac{x^{n-1} - x^{n-2}y + \ldots\ldots - xy^{n-2} + y^{n-1}}{}$$ Ans.

In the case $\sqrt{a} + \sqrt{b}$, n is even, and $= 2$.

$\therefore$ the factor is $x^{n-1} - y^{n-1}$, that is $\sqrt{a} - \sqrt{b}$. Ans.

4. (*b*) Reduce $\frac{.3}{\sqrt{5} - \sqrt{2}}$ to a fraction with a rational denominator.

Multiply numerator and denominator by $\sqrt{5} + \sqrt{2}$ and we have $\frac{3(\sqrt{5} + \sqrt{2})}{3}$ or $\sqrt{5} + \sqrt{2}$ Ans.

5. Equations—

(1) $\frac{8x - 15}{27} - \frac{5x - \frac{2x - 1}{7}}{18} - \frac{x - 30}{12} = \frac{1}{36}$

Simplifying—

$$\frac{8x - 15}{27} - \frac{33x + 1}{120} - \frac{x - 30}{12} = \frac{1}{36}$$

Multiplying up—

$$224x - 420 - 198x - 6 - 63x + 1890 = 21$$
$$37x = 1443$$
$$\therefore \quad x = 39 \text{ Ans.}$$

(2) $\sqrt{x + a} - \sqrt{x - a} = \sqrt{x}$

Squaring—

$$x + a + x - a - 2\sqrt{x^2 - a^2} = x$$
$$\text{OR,} \quad 2\sqrt{x^2 - a^2} = x$$

Squaring—

$$4x^2 - 4a^2 = x^2$$
$$\therefore \quad x^2 = \frac{4a^2}{3}$$
$$x = \pm \frac{2a}{\sqrt{3}} \text{ Ans.}$$

(3)
$$x^3 + y^3 = 1843 \quad \ldots\ldots\ldots (1)$$
$$x^2 - xy + y^2 = 97 \quad \ldots\ldots\ldots (2)$$

Dividing—
$$x + y = 19$$

Squaring this
$$x^2 + 2xy + y^2 = 361 \quad \ldots\ldots\ldots (3)$$

Subtracting (2)
$$3xy = 264$$
$$\therefore \quad 4xy = 352$$

Subtracting from (3)
$$(x - y)^2 = 9$$
$$\therefore \quad x - y = 3$$

and
$$x + y = 19$$
$$\therefore \quad x = 11$$
$$y = 8 \quad \text{Ans.}$$

6. Extract the square root of—

(1) $x^6 + 1 - 4x^5 + 4x + 6x^3 + 8x^2$

(2) $8 - 4\sqrt{3}$

(1) Arrange as follows:—

$$x^4 - 4x^3 + 6x^2 + 8x^2 + 4x + 1 \left(x^2 - 2x^2 - 2x - 1 \right.$$

$$\begin{array}{l|l} x^2 & \\ 2x^2 - 2x^2 & -4x^3 \\ & -4x^3 + 4x^4 \\ \hline 2x^2 - 4x^2 - 2x & -4x^4 + 6x^2 + 8x^2 \\ & -4x^4 + 8x^2 + 4x^2 \\ \hline 2x^2 - 4x^2 - 4x - 1 & -4x^3 + 4x^2 + 4x + 1 \\ & -4x^3 + 4x^2 + 4x + 1 \\ \hline & x^2 - 2x^2 - 2x - 1. \end{array}$$ **Ans.**

(2) Let $\sqrt{8 - 4\sqrt{3}} = \sqrt{x} - \sqrt{y}$

Squaring $x + y = 8$

$2\sqrt{xy} = 4\sqrt{3}$

$\therefore \quad 4xy = 48$

Hence $(x - y)^2 = 64 - 48$

$\therefore \quad x - y = 4$

and $x + y = 8$

$\therefore \quad x = 6$

and $y = 2$

$\therefore \quad \sqrt{8 - 4\sqrt{3}} = \sqrt{6} - \sqrt{2}$

$= \sqrt{2}(\sqrt{3} - 1)$. **Ans.**

7. A man has a certain number of crowns and florins. If the crowns were florins, and the florins crowns, his money would be increased by 12s. The square of the number of crowns and the square of the number of florins together equal 296. How many crowns and florins has he?

Let x = the number of florins.
y = the number of crowns.

Then $3(x - y) = 12$

or $x - y = 4$ ..... (1)

And $x^2 + y^2 = 296$ ..... (2)

From (1) and (2) $2xy = 280$

and $x + y = 576$ ..... (3)

From (1) and (3)

$x = 14$

$y = 10$ } Ans.

8. (*a*) The sum of the greatest and least terms in a proportion are greater than the sum of the other two.

(*b*) If $a : b :: b : c :: c : d$, then $a^3 : b^3 :: a : d$

(*a*) In the proportion, As $a : b :: c : d$ let b be the greatest. Then c will be the least. It is required to show that $b + c$ is greater than $a + d$.

Proof.—

Let $b = md$, then $a = mc$

Then $b + mc, = a + md$

$$\frac{b}{m} + c = \frac{a}{m} + d \quad \ldots\ldots\ldots (1)$$

And $\frac{b}{m} - \frac{a}{m} < b - a$

$$\therefore \quad \frac{b}{m} - b < \frac{a}{m} - a \quad \ldots\ldots\ldots (2)$$

Subtracting (2) from (1) $b + c > a + d$. Q. E. D.

(*b*) We have $\frac{a}{b} = \frac{b}{c} = \frac{c}{d}$

Hence $\frac{a}{d} = \frac{a}{b} \times \frac{b}{c} \times \frac{c}{d}$

$= \frac{a}{b} \times \frac{a}{b} \times \frac{a}{b}$

$= \frac{a^3}{b^3}$.

9. Find four numbers in *A. P.*, the sum of the squares of the extremes being 450, and of the means 306.

Let $x - 3y$, $x - y$, $x + y$, $x + 3y$ be the numbers.

$(x - 3y)^2 + (x + 3y)^2 = 450$

or $2(x^2 + 9y^2) = 450$

$x^2 + 9y^2 = 225$ ..... (1)

Also $(x - y)^2 + (x + y)^2 = 306$

Whence $x^2 + y^2 = 153$ ..... (2)

From (1) and (2) $8y^2 = 72$

$\therefore \quad y = 3$

Whence $x = 12$

$\therefore$ the numbers are 3, 9, 15, 21. Ans.

10. Two trains start from London for Birmingham, a distance of 112 miles. The first, which is a slow train, sets out at 9 a.m., and reaches Wolverton, a distance of 50 miles, a quarter of an hour after the express. The rate of the slow train is to that of the fast train as 1 : 2, and the express reaches Birmingham at 12.48 p.m. Find the rate of the slow train and the time of starting of the express.

Let x = speed of slow train in miles per hour.

Then $\frac{1}{x}$ = time to travel 1 mile.

$\therefore \quad \frac{50}{x}$ = time to travel 50 miles.

Also $\frac{1}{2x}$ = time of express in travelling 1 mile.

Hence $\frac{62}{2x} = 12\frac{4}{5} - \left(9 + \frac{50}{x} - \frac{1}{4}\right)$

or $620 = 256x - 180x - 1000 + 5x$

$\therefore \quad 81x = 1620$

$x = 20$

$\therefore$ the speed of the fast train is 40 miles per hour, and the time of starting

$= \left(12.\frac{48}{60} - \frac{112}{40}\right)$ a.m.

$= 10$ a.m.

20 miles per hour; 10 a.m. Ans.

11. The Geometric Mean between two numbers is 12, and the Harmonic Mean $11\frac{1}{25}$.

Find the numbers.

Let a and b be the numbers.

Then $\sqrt{ab} = 12$ ..... (1)

$\frac{2ab}{a + b} = \frac{288}{25}$ ..... (2)

Squaring (1) and multiplying by 2.

Hence from (2) $2ab = 288$

$a + b = 25$

$(a - b)^2 = 625 - 576$

$= 49$

$\therefore \quad a - b = 7$

And $a + b = 25$

$\therefore \quad a = 16$

$b = 9$ } Ans.

Mensuration.

1. How many panes of glass each $4\frac{3}{4}$ by $3\frac{1}{2}$ inches will be required for a window with a semicircular head, whose extreme height is 35 feet and width 14 feet?

Area of window $= \left\{\left(\frac{1}{2} \times \frac{22}{7} \times 49\right) + (28 \times 14)\right\}$ sq. ft.

$= 469$ sq. ft.

Area of pane $= \frac{19}{4} \times \frac{7}{2} \times \frac{1}{144}$ sq. ft.

$\therefore$ number of panes $= \frac{469 \times 3 \times 5 \times 144}{14 \times 19}$

$= 4020$ panes. Ans.

2. A rectangular field contains $1\frac{1}{2}$ acres; the distance between opposite corners is $6\frac{1}{2}$ chains. Find the length and breadth of the field.

Let x be the length of the field.
And y be the breadth of the field,

Then $xy = 7260$ sq. yds.

$\sqrt{x^2 + y^2} = 143$ yds.

Hence $2xy = 14520$ ..... (1)

And $x^2 + y^2 = 20449$ ..... (2)

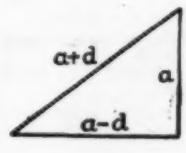
From (1) and (2) $x + y = 187$

$x - y = 77$

$\therefore \quad x = 132$ yds.

$y = 55$ yds. } Ans.

3. If the sides of a right-angled triangle are in AP, to what numbers are they proportional?



Let the sides be $a - d$, a, $a + d$.
We have $(a - d)^2 + a^2 = (a + d)^2$; OR,
$a^2 = 4ad$.
$\therefore a = 4d$.
Hence if a is 4, the sides will be represented by 3, 4, 5. Ans.

Algebra.
SECOND YEAR.

1. Multiply—
$x^{\frac{3}{2}} + y^{\frac{3}{2}} + z^2 - y^{\frac{3}{2}}z - zx^{\frac{1}{2}} - x^{\frac{1}{2}}y^{\frac{3}{2}}$, by $x^{\frac{1}{2}} + y^{\frac{3}{2}} + z$.

And Simplify—

$$\left\{\frac{a}{a - \sqrt{a^2 - x^2}} - \frac{a + \sqrt{a^2 - x^2}}{a}\right\}$$
$$\left\{\frac{a}{a + \sqrt{a^2 - x^2}} - \frac{a - \sqrt{a^2 - x^2}}{a}\right\}$$

$x^{\frac{3}{2}} + y^{\frac{3}{2}} + z^2 - y^{\frac{3}{2}}z - zx^{\frac{1}{2}} - x^{\frac{1}{2}}y^{\frac{3}{2}}$

$x^{\frac{1}{2}} + y^{\frac{3}{2}} + z$

$x + x^{\frac{1}{2}}y^{\frac{3}{2}} + x^{\frac{1}{2}}z^2 - x^{\frac{1}{2}}y^{\frac{3}{2}}z - x^{\frac{3}{2}}z - x^{\frac{3}{2}}y^{\frac{3}{2}}$
$- x^{\frac{1}{2}}y^{\frac{3}{2}} \quad - x^{\frac{1}{2}}y^{\frac{3}{2}}z + x^{\frac{3}{2}}y^{\frac{3}{2}} + y^3 + y^{\frac{3}{2}}z^2 - y^{\frac{3}{2}}z$
$- x^{\frac{1}{2}}z^2 - x^{\frac{1}{2}}y^{\frac{3}{2}}z + x^{\frac{3}{2}}z \quad - y^{\frac{3}{2}}z^2 + y^{\frac{3}{2}}z + z^3$

$x + y^3 + z^3 - 3x^{\frac{1}{2}}y^{\frac{3}{2}}z$. Ans.

$$\left\{\frac{a}{a - \sqrt{a^2 - x^2}} - \frac{a + \sqrt{a^2 - x^2}}{a}\right\}$$
$$\left\{\frac{a}{a + \sqrt{a^2 - x^2}} - \frac{a - \sqrt{a^2 - x^2}}{a}\right\}$$
$$= \frac{a^2 - a^2 + a^2 - x^2}{(a - \sqrt{a^2 - x^2})\,a} \times \frac{a^2 - a^2 + a^2 - x^2}{(a + \sqrt{a^2 - x^2})\,a}$$
$$= \frac{(a^2 - x^2)^2}{a^2x^2}$$ Ans.

2. Equations—

(a)
$$\left.\begin{aligned} 3x + 4y + z &= 4 \\ x + y + z &= 1\tfrac{1}{2} \end{aligned}\right\} \ldots\ldots\ldots (1)$$
$$\left.\begin{aligned} x + y + z &= 1\tfrac{1}{2} \\ 3x + 2y &= 2 \end{aligned}\right\} \ldots\ldots\ldots (2)$$
$$\left.\begin{aligned} 3x + 2y &= 2 \\ 7x + 7y &= 5\tfrac{1}{2} \end{aligned}\right\} \ldots\ldots\ldots (3)$$

Adding— $7x + 7y = 5\frac{1}{2}$
or $x + y = \frac{11}{14}$
Substituting in (2) we have $z = 1\frac{1}{2} - \frac{11}{14} = 1$
Hence— $3x + 4y = 3$, $3x + 2y = 2$
Subtracting $2y = 1$
$\therefore y = \frac{1}{2}$
$\therefore 3x + 2 = 3$
$3x = 1$
$x = \frac{1}{3}$

$\frac{1}{3}, \frac{1}{2}, 1$. Ans.

(b) $$1 - \frac{7}{x - 20} = \frac{7x}{2x^2 - 41x + 20} - \frac{x}{2x - 1}$$

Multiplying up—
$2x^2 - 41x + 20 - 14x + 7 = 7x - x^2 + 20x$
or $3x^2 - 82x + 27 = 0$
$\therefore x = \frac{82 \pm \sqrt{6724 - 324}}{6}$
$= 27$, or $\frac{1}{3}$. Ans.

(c)
$$\left.\begin{aligned} \frac{\sqrt{x}}{y} + \frac{\sqrt{y}}{x} &= \frac{5}{2} \end{aligned}\right\} \ldots\ldots\ldots (1)$$
$$\left.\begin{aligned} \frac{x}{\sqrt{y}} + \frac{y}{\sqrt{x}} &= \frac{9}{\sqrt{2}} \end{aligned}\right\} \ldots\ldots\ldots (2)$$

Put z for $\frac{\sqrt{x}}{y}$

Then we have $z + \frac{1}{z} = \frac{5}{2}$
Whence $z = 2$ or $\frac{1}{2}$ ..... (3)
That is $\frac{x}{y} = 4$ or $\frac{1}{4}$
$x = 4y$ or $\frac{1}{4}y$
$y = \frac{1}{4}x$ or $4x$

From (2) and (3) taking the first value of z

$$2\sqrt{x} + \tfrac{1}{2}\sqrt{y} = \frac{9}{\sqrt{2}}$$

Substituting for x $4\sqrt{y} + \frac{1}{2}\sqrt{y} = \frac{9}{\sqrt{2}}$

$$\therefore \sqrt{y} = \frac{9}{\sqrt{2}} + \frac{2}{9}$$

$\therefore y = 2$
Whence $x = 8$

And since the second value of z is the reciprocal of the first, we have two other values of x and y which are reciprocal to these.

$\therefore x = 8$ or 2, $y = 2$ or 8 Ans.

3. Show that $2p =$ the sum, $q =$ the product, $2\sqrt{p^2 - q}$ the difference of the roots of the equation $x^2 - 2px + q = 0$. Hence, show that if a, b, are the roots of this equation, $a + c$, $b - c$, the roots of $x - 2px + r = 0$, then

$c^2 + 2c\sqrt{p^2 - q} - q + r = 0$
$x^2 - 2px + q = 0$
$\therefore x^2 - 2px + p^2 = p^2 - q$
$x - p = \pm\sqrt{p^2 - q}$
$\therefore x = p \pm \sqrt{p^2 - q}$

Hence, the sum of roots $= p + \sqrt{p^2 - q} + p - \sqrt{p^2 - q}$
$= 2p$
Their difference $= p + \sqrt{p^2 - q} - p + \sqrt{p^2 - q}$
$= 2\sqrt{p^2 - q}$
Their product $= (p + \sqrt{p^2 - q})\,(p - \sqrt{p^2 - q})$
$= p^2 - p^2 + q$
$= q$
In the equation $x^2 - 2px + q = 0$
we have $a - b = 2\sqrt{p^2 - q}$
$ab = q$
In the equation $x^2 - 2px + r = 0$
$(a + c)\,(b - c) = r$

Substituting these values in

$c^2 + 2c\sqrt{p^2 - q} - q + r$
$= c^2 + 2c\left(\tfrac{1}{2}\{a - b\}\right) - ab + (a + c)\,(b - c)$
$= c^2 + ac - bc - ab + ab - ac + bc - c^2$
$= 0$

4. A shopkeeper buys £40 worth of calico from a manufacturer, and retails it at a profit of £12. He again buys £40 worth; but getting 160 yards more for his money, retails it at ½d. per yard less than before, and yet makes the same profit. What price per yard did he charge?

Let $x =$ his original price per yard in halfpennies.

Then the number of yards in first sale $= \frac{52 \times 480}{x}$

Thus we have $\frac{52 \times 480}{x} + 160 = \frac{52 \times 480}{x - 1}$

Or, $24960x - 24960 + 160x^2 - 160x = 24960$
$x^2 - x - 156 = 0$
$(x + 12)\,(x - 13) = 0$
$\therefore x = -12$ or 13

Taking the positive value, the price is 6½d. Ans.

5. Show that if an expression containing positive integral powers only of x vanishes when a is substituted for x, then the expression is exactly divisible by $x - a$.

Hence or otherwise prove that—

$(a - b)\,a^2b^2 + (b - c)\,b^2c^2 + (c - a)\,c^2a^2 + (a - b)\,(b - c)\,(c - a)\,(bc + ca + ab) = 0$.

Let $x^n + p_1x^{n-1} + p_2x^{n-2} + \ldots\ldots\ldots p_{n-1}x + p_n$

be an expression containing positive integral powers only of x.

Represent it by P.

By dividing P by $x - a$, we shall arrive at a remainder not containing x.

Let Q be the quotient, and R the remainder.

Then $P = Q\,(x - a) + R$.

Supposing the expression to vanish when a is substituted for x,

We get $Q \times 0 + R = 0$. $\therefore R = 0$.

Hence the expression is exactly divisible by $x - a$.

To show that—

(1) ..... $(a-b)\,a^2b^2 + (b-c)\,b^2c^2 + (c-a)\,c^2a^2 + (a-b)(b-c)(c-a)(bc+ca+ab) = 0$

$$\begin{aligned}
&(a-b)\,a^2b^2 + (b-c)\,b^2c^2 + (c-a)\,c^2a^2\\
&= (a-b)\,a^2b^2 + b^2c^2 - b^2c^2 + c^2a^2 - c^2a^2\\
&= (a-b)\,a^2b^2 - (a^2-b^2)\,c^2 + (a^2-b^2)\,c^2\\
&= (a-b)\,a^2b^2 - (a-b)\,(a^2c^2 + abc^2 + b^2c^2) + (a-b)\,(ac^2+bc^2)\\
&= (a-b)\,(a^2b^2 - a^2c^2 - abc^2 - b^2c^2 + ac^2 + bc^2)\\
&= (a-b)\,[a^2\,(b^2-c^2) - ac^2\,(b-c) - bc^2\,(b-c)]\\
&= (a-b)\,(b-c)\,(a^2b + a^2c - ac^2 - bc^2)\\
&= (a-b)\,(b-c)\,[-ac\,(c-a) - b\,(c^2-a^2)]\\
&= (a-b)\,(b-c)\,(c-a)\,(-ac-bc-ab)\\
&= -(a-b)\,(b-c)\,(c-a)\,(bc+ca+ab)
\end{aligned}$$

Substituting this in (1) we have—

$-(a-b)(b-c)(c-a)(ab+bc+ca) + (a-b)(b-c)(c-a)(ab+bc+ca) = 0.$

6. Let A, G, H be the Arithmetical, Geometrical, and Harmonic means between a and b.

Then $$A = \frac{a+b}{2}$$

$$H = \frac{2ab}{a+b}$$

$$G = \sqrt{ab}$$

$$AH = \frac{a+b}{2} \times \frac{2ab}{a+b} = ab$$

$$= G^2.$$

∴ A, G and H are in Geometric Progression.

Prove that if the middle term be added to each of three consecutive terms of a G.P. the resulting terms are in H.P.

Let a, ar, ar^2 be three consecutive terms of a G.P.

Adding ar to each, we get $a + ar$, $2ar$, $ar^2 + ar$.

To show that $$\frac{a+ar}{ar^2+ar} = \frac{a+ar-2ar}{2ar-ar^2-ar}$$

$$\frac{a+ar}{ar^2+ar} = \frac{a(r+1)}{ar(r+1)} = \frac{1}{r}$$

$$\frac{a+ar-2ar}{2ar-ar^2-ar} = \frac{a(1-r)}{ar(1-r)} = \frac{1}{r}$$

∴ $a + ar$, $2ar$, $ar^2 + ar$ are in H.P.

7. When is one quantity said to vary (*a*) directly (*b*) inversely as another?

A locomotive engine without a train can go 24 miles per hour, and its speed is diminished by a quantity which varies as the square root of the number of waggons attached. With 4 waggons its speed is 20 miles an hour. Find the greatest number of waggons which the engine can move.

(*a*) One quantity, A, is said to vary directly as another, B, and when the two quantities depend upon each other in such a manner, that if B is changed A is changed in the same ratio.

(*b*) One quantity, A, is said to vary inversely as another, B, when A varies directly as the reciprocal of B.

Let w = the number of waggons.

Then $\sqrt{wm}$ = the quantity which diminishes the speed of the train, m being a constant.

Hence $$24 - \sqrt{4m} = 20$$

$$\therefore \quad m = 2$$

∴ the number of waggons the engine is just unable to move is found from

$$24 - \sqrt{w2} = 0$$

$$\therefore \sqrt{w} = 12$$

$$w = 144$$

∴ Greatest number the engine can move is 143. Ans.

8. Find the number of combinations of n things r at a time.

(*a*) How many different throws can be made with two dice numbered, as usual, 1 to 6?

First part — Bookwork.

(*b*) Number of throws, the No. 1 appearing each time =

Number of new throws, the No. 2 appearing each time = 5

Ditto do. No. 3 do. = 4

Ditto do. No. 4 do. = 3

Ditto do. No. 5 do. = 2

Ditto do. No. 6 do. = 1

∴ total number of different throws is $6 + 5 + 4 + 3 + 2 + 1$.

$= 21$. Ans.

9. Assuming that the coefficient of x^r in the expansion of $(1+x)^n$ is $\frac{\lfloor n}{\lfloor r \,\lfloor n-r}$

Find the coefficient of x^n in the expansion of $(1+x)^n + 1$.

Write down the first three and the middle terms of $\left(\frac{x}{a} + \frac{a}{x}\right)^{2n}$

The coefficient of $(1+x)^r$ is $\frac{\lfloor n}{\lfloor r \,\lfloor n-r}$

Substitute $n+1$ for n, and we get the new coefficient—

$$\frac{\lfloor n+1}{\lfloor r \,\lfloor n-r+1}$$

$$\left(\frac{x}{a} + \frac{a}{x}\right)^{2n}$$

First Term .. .. = $\left(\frac{x}{a}\right)^{2n}$

Second Term .. = $2n\left(\frac{x}{a}\right)^{2n-2}$

Third Term .. .. = $n(2n-1)\left(\frac{x}{a}\right)^{2n-4}$

Middle Term .. = $\frac{\lfloor 2n}{\lfloor n \,\lfloor n}$

} Ans.

10. Define the term 'Logarithm,' 'Characteristic,' 'Mantissa.' Why is the characteristic omitted in tables calculated to base 10?

Having given $\log_{10} 2 = .30103$.

$\log_{10} 3 = .47712$.

Find $\log_{10} 4050$, and $\log_{10} .00405$.

First Part — Bookwork.

$$\begin{aligned}
\text{Log. } 405 &= \log.\,(5 \times 3^4).\\
&= 1 - \log. 2 + 4 \log. 3.\\
&= 1 - .30103 + 1.90848.\\
&= 2.60745.
\end{aligned}$$

Hence log. 4050 = 3.60745
And log. .00405 = $\overline{3}$.60745
} Ans.

11. Find the amount of £P in n years at 100r per cent. compound interest.

Show that a sum of money allowed to accumulate in the Two and a Half per Cents. will more than double itself in 29 years.

The amount of £1 in 1 year $= 1 + \frac{100r}{100}$

$= 1 + r$

∴ Amount of £P in n years $= P(1+r)^n$

Let P be the principal and M the amount.

Then $$M = P\left(\frac{41}{40}\right)^n$$

or $$\frac{M}{P} = \left(\frac{41}{40}\right)^n$$

Hence log. $\frac{M}{P} = 29 \log. \left(\frac{41}{40}\right)$

$$= \frac{46.77062}{46.45974}$$

$$= 1.006$$

$$\therefore \quad \frac{M}{P} > 2$$

Hence a sum of money accumulating as above will more than double itself in 29 years.

Mensuration.

1. A cone and a hemisphere have equal bases and equal volumes; find the ratio of their heights.

Let H be the height of the cone.

And R be the radius of the base.

Then R will also be the height of the hemisphere.

We have $\frac{1}{2}\pi R^2 H = \frac{1}{2}(\frac{2}{3}\pi R^3)$

or $H = 2R$

$\therefore \quad \frac{H}{R} = \frac{2}{1}$

That is height of cone is height of hemisphere.

$\therefore$ 2 : 1

2. One quarter of the volume of a cylindrical boiler 12 ft. long and 5 ft. in diameter internally is fitted with cylindrical heating tubes fitted longitudinally and 7½ in. in diameter. Find the number of tubes and the ratio of the total heating surface to the surface of the boiler.

$$\text{Number of tubes} = \frac{\text{volume occupied by pipes}}{\text{volume of each pipe}}$$

$$= \frac{\frac{1}{4} \times \frac{25}{4} \times 12\pi}{\left(\frac{15}{48}\right)^2 12\pi}$$

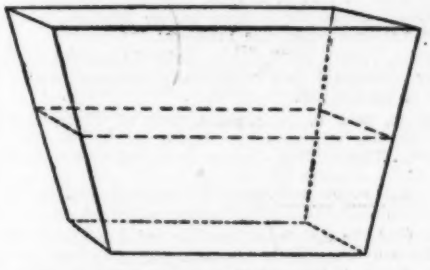
$$= \frac{25}{4} \times \frac{1}{4} \times \frac{48}{15} \times \frac{48}{15} = 16$$

$$\frac{\text{Heating surface}}{\text{surface of boiler}} = \frac{16 \times \frac{15}{48} \times 2 \times \pi \times 12}{2 \times \pi \times \frac{5}{2} \times 12}$$

$$= \frac{2}{1}$$

16 pipes; 2 : 1. Ans.

3. A prismoidal tub has a rectangular base 2 ft. by 1 ft., and a top 2 ft. 9 in. by 1 ft. 9 in., and is 18 in. deep. Find how much water it contains, having given that a cubic foot of water weighs 1,000 ounces and a gallon weighs 10 lb.



Area of middle section $= \frac{1}{2}(2\frac{3}{4} + 2) \times \frac{1}{2}(1\frac{3}{4} + 1)$

$= \frac{209}{88}$ sq. ft.

Area of base $= 2$ sq. ft.

Area of top $= \frac{77}{16}$ sq. ft.

Volume of prismoid $= \frac{3}{2} \times \frac{1}{6}\left\{\left(4 \times \frac{209}{64}\right) + \frac{77}{16} + 2\right\}$

$= \frac{159}{32}$ cubic ft.

Hence, quantity of water $= \left(\frac{159}{32} \times \frac{1000}{16} \times \frac{1}{10}\right)$ gals.

$= 31{\cdot}06$ gals. Ans.

Arithmetic.

1. $\frac{\cdot 461538 \times 29{\cdot}25}{65{\cdot}52 \times 142857}$ of 2 cwt. 1 qr. 8 lb.

$= \left\{\frac{3}{\cancel{\cdot 461538} \times \cancel{29{\cdot}25}} \times \frac{25}{\cancel{65{\cdot}52}} \times \frac{5}{\cancel{142857}}\right\}$ lb.

$= 375$ lb.

$= 3$ cwt. 1 qr. 11 lb. Ans.

2. Define Present Worth, True Discount, Bankers' Discount.

The difference between the true and bankers' discount on a sum of money due at the end of 2 years and 8 months at 3½ per cent per annum simple interest is £7 5s. 7½d. What sum is due?

Let P = the amount due.
n = number of years.
r = interest on £1 for 1 year.

We have $Pnr - \frac{Pnr}{1+nr} = \frac{3495}{480}$

or, $480\,P(nr)^2 = 3495 + 3495nr$

Substituting for nr $\frac{480P}{100} = 3495 + \frac{3495}{10}1$

$\therefore \quad 48P = 38445$

And $P =$ £800 18s. 9d. Ans.

3. Find the compound interest on £2666 13s. 4d. for 4 years at 2½ per cent.

Amount of £1 in 1 year $= £\frac{205}{200} = \frac{41}{40}£$

$\therefore$ Amount of £2666 13s. 4d. in 4 years $= £\frac{8000}{3} \times \left(\frac{41}{40}\right)^4$

$= \frac{2825761}{960}$

$=$ £2943 10s. 0½d.

$\therefore$ Interest = £2943 10s. 0½d. — £2666 13s. 4d.

= £276 16s. 8½d. Ans.

4. A minute of latitude contains 6080 ft., and a metre is the 10,000,000th part of a quadrant of the meridian.

A kilogram is the weight of the one-thousandth part of a cubic metre of water, and a cubic foot of water weighs a thousand ounces. Express a kilogram in ounces to two places of decimals.

Length of metre $= \frac{6080 \times 90 \times 60}{10{,}000{,}000}$

$= 3{\cdot}2832$ ft.

$\therefore$ A cubic metre $= (3{\cdot}2832)^3$ cubic ft.

$= 35{\cdot}40092$ cubic ft.

Hence number of ounces in a kilogram—

$= 35{\cdot}40092$ oz. Ans.

THE attention of First Year Students who desire a practical illustration of 'sense training' is drawn to the account of the Infant Department of the Hill-head Public School, which appeared in the 'INFANTS' MISTRESS' for July 22nd. It will repay careful study, especially the middle column of page 2.

AUGUST, 1893.

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FIRST YEAR WOMEN.

GEOGRAPHY.

I. Draw a map of the East Coast of Africa, showing the boundaries of the territories influenced or possessed by European Powers. (See any recent edition of a good Atlas.)

II. '*In relation to foreign commerce, Morocco can be described only as a country of possibilities.*' (*a*) Explain this, and (*b*) show by what means its trade and prosperity might be greatly increased.

(*a*) The Government of Morocco is a despotism tempered by insurrections, and the country is never in a complete state of political quietude.

The people are as a rule proud, indolent, jealous of foreigners, and bigoted Islamites.

The means of communication are almost absent; what interior trade there is being carried on by caravans. There is no native industry, except the wide-spread one of leather-making, and the manufacture of red caps at Fez.

On the other hand, the flora includes wheat, barley, millet, maize, the vine, date palm, gum trees, cork, oak, pine, almond, olive, peas, and beans. The fauna comprises the rabbit, goat, horse, ox, sheep, ostrich, and poultry.

Copper and iron are found in considerable quantities.

Summing up, it will be seen that the natural products and capabilities would lead us to expect a commerce of considerable magnitude, but that the indifference and opposition of the inhabitants prevent its development. Obstacles being removed, the *possibilities* of trade would evolve into actualities.

(*b*) Morocco requires (1) a strong Government; (2) an abatement of the jealousy felt towards each other by England, France, Spain, and Italy; (3) the construction of lines of railway from the interior to the principal ports; (4) the establishment of a system of irrigation by means of artesian wells, and the enlightenment of the inhabitants. Trade would then certainly prosper.

III. (*a*) What physical features of Africa have been a bar to its development? (*b*) How can you account for the remarkable absence of bays and gulfs along its coast?

(*a*) The situation of many of the African mountains, close to the coast, the fringe of malarious swampland along the sea-board, the absence of penetrating arms of the sea, the paucity of harbours, coast islands, and navigable rivers, its vast deserts, and its disconnection from the other great land masses, have all retarded the opening-out of the 'Dark Continent.'

(*b*) The remarkable absence of gulfs and bays in Africa is due to:—

(1) Its geological formation, which has placed many of the primary rocks upon its coast line.

(2) Its remarkable extent of coast ranges, enclosing vast central plateaus.

(3) Its comparative dearth of great rivers, and the consequent absence of estuaries; and

(4) The direction of the coast currents and prevailing winds.

IV. (*a*) Some portions of Africa receive large quantities of rain, and some are almost rainless. (*b*) How do you account for these conditions? Explain why the chief characteristics of desert climates are intense heat by day and severe cold by night.

(*a*) Drought is the great feature over all northern Africa. There N.E. winds prevail, and these arriving from cooler latitudes and having passed over Asia are ready to absorb, not impart, moisture.

Likewise in the far south, the most frequent winds are the S.E. trades, and these are denuded of their moisture (gathered from the Indian Ocean) by the elevated coast ranges.

On the other hand the central region has a copious rainfall, for to that portion lying beneath the tropical sun rush as to a common centre the winds from all quarters. On the northern and southern sea-boards the rainfall comes in winter.

(*b*) In desert regions the bare ground affords no cover for moisture and no retardation of quick absorption and rapid radiation. Neither does the rainless and cloudless sky prevent the passage of the direct sun rays or their reflection into space. Accordingly, the ground and the lowest stratum of air become intensely heated by day, but, quickly losing their calor, become severely cold by night.

V. (*a*) What is the principal religion in the northern half of Africa? (*b*) In what parts do we find the densest population?

(*a*) Mohammedanism is the principal religion of northern Africa. Spread far and wide by the Arabs, its propagation has been zealously undertaken in the Soudan by that remarkable negro race the Fellatah. About 50,000,000 Africans are the followers of the prophet of Mecca.

(*b*) The densest population of northern Africa is to be found in Egypt, Morocco, Algeria, and part of Abyssinia.

VI. Where in Africa do we find (*a*) Haussas, (*b*) Berbers, (*c*) Pygmies, (*d*) Kaffirs, and (*e*) Masai? Mention any peculiar characteristics of each.

(*a*) The *Haussas* occupy the central province of the kingdom of Sokoto in the interior of the Soudan. They are an intelligent and brave negro race, whose services we utilise as levies for tropical climates.

(*b*) *The Berbers* (βαρβαροι), from whom the Barbary States derive their name, are a people of Hamitic origin, with slim, sinewy forms, sharply-cut features, black fiery eyes, and black hair. Their language is still spoken across all north Africa.

(*c*) *The Pygmies* are a race of dwarfs discovered in the forests N.E. of the Congo Basin by Stanley in his recent Emin Relief Expedition. They appear to be the remains of a much more numerous people mentioned by the old geographers.

(*d*) *The Kaffirs* dwell in Caffraria, to the N.W. of Cape Colony, Natal, Transvaal, etc., and in fact their varied tribes—the Bechuana, Basuto, Zulu, Makatee, Matabele, Makolole—out-number all the other races of South Africa. They are a tall, dark-brown species of man, lithe and active, good hunters, warriors, and shepherds, but bad agriculturists.

(*e*) *The Masai*, a fine, well-formed race of Hamitic origin, with lively eyes and deep-brown complexion, are war-like nomads inhabiting the extensive tableland between the mountains of Kenia and Kilima-njara and the eastern borders of the Victoria Nyanza.

VII. (*a*) Name the independent States of Africa. What portions of Africa belong (*b*) to Turkey, and (*c*) to France?

(*a*) Morocco, Abyssinia, Liberia, Ashantee, Dahomey, Yoruba, Benin, Old Calabar, the Soudan States, Zanzibar, Congo Free State, Orange Free State, The Transvaal.

(*b*) Fezzan, Tripoli, and Egypt are under the nominal suzerainty of of Turkey, although Tripoli is practically independent and Egypt occupied by the English.

(*c*) Algiers, part of Senegambia, part of Upper and Lower Guinea Coasts, an extensive region north of the Congo, Madagascar, Reunion, the Comero Isles, and Obock, in the Red Sea.

VIII. (*a*) How was the British Protectorate over the island of Zanzibar obtained? Why is this Protectorate important to England?

(*a*) In 1888 the Sultan of Zanzibar ceded to the British East Africa Company a portion of the coast, extending from opposite the island of Pemba to the River Ozo. Shortly afterwards he ceded another portion of his coast beyond Witu. Between these was a German possession, the sultanate of Witu. In June, 1890, an arrangement was arrived at between the British and German Governments, Heligoland, off the German coast, being given up by the British in return for the German cession of Zanzibar, the sultanate of Witu, and a part of the coast of Somauliland.

(*b*) The Zanzibar Protectorate is important, as:—

(1) Completing the continuity of our coast line in East Africa;

(2) Enabling us to strike a fatal blow at the slave-trade;

(3) Furnishing us with a good and much-needed harbour;

(4) Securing to England the best passage to the head-waters of the Nile;

(5) Providing us with an island very easily defended by a great maritime Power, and a very convenient half-way house along the East Coast.

IX. Describe the position of the following, and state briefly what you know of each:—

(*a*) Walvisch Bay, (*b*) Sierra Leone, (*c*) Mount Kenia, (*d*) Sofala, (*e*) The Stevenson Road, (*f*) Massowah, (*g*) Monrovia, (*h*) Cameroon, (*i*) The Great Karoo, and (*j*) Pretoria.

(*a*) *Walvisch Bay* is an isolated dependency of Cape Colony in Damaraland. From it tracks lead inward to mission stations. It is the only good harbour for hundreds of miles, and is a whaling station, hence its name.

(*b*) *Sierra Leone* lies to the south of the Gambia Settlements, on the west coast of Africa. Its area is about 470 square miles, its population is 40,000, nearly all liberated slaves or their descendants. Freetown is the capital.

(*c*) *Mount Kenia*, 18,000 feet high, is at the south of an extensive plateau, and midway between Victoria Nyanza and the coast.

(*d*) *Sofala* is a small port and bay, belonging to the Portuguese, on the south-east coast, and north of Gasaland.

(*e*) *The Stevenson Road*, constructed at the expense of Mr. Stevenson, connects the head of the Nyassa with the Tanganyika.

(*f*) *Massowah*, a seaport on the west coast of the Red Sea, opposite the Dahlak group of islands, was occupied nine years ago by the Italians. It is the natural outlet of Abyssinia to the sea.

(*g*) *Monrovia*, the capital of Liberia, is situated on the west coast of Africa, within the shelter of Cape Mesurado, south of Sierra Leone. Liberia was founded by an American society to serve as a nome for liberated slaves; and its capital was named after Mr. Monro, a noted President of the United States.

(*h*) *Cameron Mountains* and the Peak of Cameroons are mountains about 13,000 feet high, near the Bight of Biafra. They form part of a remarkable volcanic belt. The district belongs to Germany.

(*i*) *The Great Karoo* consists of wide undulating plains situated in Cape Colony beyond the Zwartebergen. Throughout this track of 200 miles farms are few, trees are absent, and water is scarce, but after rain the whole plain is carpeted with lovely vegetation. The whole district is divided into sheep-runs, and furnishes most of the wool exported.

(*j*) *Pretoria*, on the central plateau of the Transvaal, is the capital, though not the largest town of that State.

X. (*a*) What animals are peculiar to Africa? (*b*) State the chief articles exported by Cape Colony.

(*a*) The hippopotamus, the giraffe, the zebra, quagga, gorilla, many species of deer, the python, and the ostrich are (or were until recently) peculiar to Africa. In addition, the lion, elephant, camel, and crocodile are distinct from their fellows in other continents. Of 350 species of African quadrupeds, 250 are either peculiar to the continent, or have had there their origin.

(*b*) The principal articles exported from Cape Colony are wool, wine, horses, copper, hides, fruit, diamonds, ivory, and ostrich feathers.

XI. (*a*) Describe the principal causes of currents. (*b*) Show how the climate of the United Kingdom is influenced by any particular current.

(*a*) The principal causes of currents are:—

(1) The diurnal revolution of the earth.

(2) The stress of prevailing winds.

(3) The difference in temperature and, consequently, of evaporation.

(1) Because our globe revolves to east from west the circular motion diminishes from the equator to the poles, as the circles of rotation are smaller. Therefore water flowing (say) due north from the equator to the poles, when it arrives at higher latitudes, travels to the east (because of the motion imparted at the equator) faster than the parts where it has arrived.

The N. motion thus becomes one to the N.E. Similarly, the under-currents from the poles get left behind and are translated from S. and N. currents to S.W. and N.W. ones respectively.

(2) It is easy to understand and even to illustrate how the impulse of prevailing winds causes surface currents.

(3) At the equator the heated water expands and becomes lighter. An immense quantity is also removed by evaporation. Hence, equilibrium being destroyed the heavier water from the poles flows in an under-current to supply the place of the evaporated water and to displace the expanded water. In return the surface water is pushed towards the poles, and a constant circulation thus ensues.

(*b*) The effect of the ocean circulation in ameliorating climate is nowhere more strikingly exemplified than on the European coasts, where the warm S.W. flow from the temperate regions of the Atlantic in the line of the Gulf Stream keeps the harbours of the British Isles, and Norway to its most northerly point, free of ice throughout the year, whilst on the opposite side of the Atlantic the coast is blocked with ice throughout the year in latitudes south of those of the British Isles.

Great Britain is warmer, less subject to extremes, and more humid through the influence of the Gulf Stream.

XII. (*a*) What is the cause of the annual rise of the water in the Nile? (*b*) When does the rise begin, and how long is it before it reaches its usual height? (*c*) Describe its effects on Lower Egypt. (*d*) What crops are grown there by perennial irrigation?

(*a*) The increase in the volume of the Blue Nile through the melting snow, but chiefly through the periodical rains on the high and rocky plateau of Abyssinia during the months of March and April, causes the periodicity of the rise of the Nile.

(*b*) The augmentation in volume begins early in June almost to the day, and continues until the first week of October, the maximum increase in height being from 20 to 30 feet. A constant level is then maintained for about a fortnight, then abatement commences, and by November 10th half the flood has subsided, and by the end of November the true inundation has ceased.

(*c*) In Lower Egypt the Nile overflows its banks on either side for several miles, and many miles beyond the immediate inundation the ground is cut up by canals which both extend the flood and convey the water into reservoirs for perennial use.

(*d*) The principal crops grown by perennial irrigation are rice, cotton, wheat, flax, hemp, and tobacco.

REVIEWS.

Univ. Corr. Coll. Tutorial Series: A Manual of Ethics. By John S. Mackenzie, M.A., Fellow of Trinity College, Cambridge, Assistant Lecturer on Logic and Philosphy, and Cobden Lecturer on Political Economy in the Owens College, Manchester.

The most characteristic feature of this work is its breadth of view. The subject requires it, and the demand has been adequately complied with. From the title page we learn that it is designed "*for the use of students*," and if the term *students* be extended to include not only candidates for examinations, but investigators of truth in general, we can testify to the fit use thereof. Pilate asked, "'*What is truth?*' and would not stay for an answer." Mr. Mackenzie both propounds the query, and supplies the reply. In these days of introspection and personal inquiry, when the beliefs of our fathers do not supply sufficient moral foundation without our own independent and individual acquiescence, such a volume as this (and we know no better) will be cordially welcome to every clergyman, schoolmaster, and honest politician. The divergence from and relation of ethics to kindred sciences, are most accurately defined, its history and development very amply dealt with, the precepts and principles of great moralists, from Aristotle to Spencer and Matthew Arnold, are examined and pronounced upon, and a sound substructure are laid down, not only for scholarly attainment, but for personal conviction. Particularly good is the examination and explanation of the Kantian principle. We have been able to catch the author tripping but once, and then in a minor illustrative point. On page 9 we learn that "*there is no science of cookery*," and on p. 18 the "*laws of cookery*" are spoken of. There is also a most valuable appendix on "*Hints on Further Reading*." By this time every one knows the material and uniform excellence of this series, of which the book under consideration is fully worthy. We cannot close without extolling the magnanimity of the compiler. The warmth of commendation Mr. Mackenzie bestows upon many kindred works is most noteworthy in these days of mean-spirited rivalry.

French Epitome of Grammar for Pupil-Teachers. By L. B. Bernhart, B.A., Macclesfield.

From a Teacher's point of view this little work will be found very valuable. It is beautifully printed on excellent paper, with alternate pages left blank for notes.

At a glance the essential points are visible to the student, and the arrangement of such tables as those of the Conjugations, makes comparison between them a pleasure.

M. Bernhart has had large and varied experience as a Teacher of French, and not only his exhibition of the salient features of the language, but of the examination 'catches,' amply evidence this. Every Pupil-Teacher should buy it.

Le Chat Botté, and other fairy tales. By L. B. Bernhart, B.A., Macclesfield.

This book will be very popular with young readers of French. Not only is it well graduated, and in simple language, but the compiler has cunningly contrived to employ many words that are identical with, or similar to, those of our own tongue. This device ensures that many purely French words are learnt merely from the context. At the end is a very full and accurate vocabulary.

University Correspondence College Tutorial Series: History of England, 1640—1670. By C. S. Fearenside, M.A., Oxon. London: W. B. Clive and Co.

For the Intermediate Arts' examination in the University of London, next year, candidates are required specially to study the period of English history from 1640 to 1670—the period which embraces the Civil War, the Commonwealth, and the Restoration. This book is prepared to assist candidates in this special study. It belongs therefore to a class of books which may be characterised as time-saving and also time-serving. Such books have both advantages and disadvantages. If they save the student time and trouble, they are apt to favour the cramming method. For real educational value, it is more than doubtful whether a highly condensed summary of standard books on a subject is equal to the careful reading of the necessary portion of one of the leading authorities. Specially written books are apt to show signs of haste, to be too closely packed, and therefore forbidding, or at least rather dry. The book before us is not dry. It opens with a general introduction, dealing with the previous course of English history, as if the author would by the use of a few bold sweeping strokes make a background for his detailed picture. There is ample evidence, in the six chapters into which the remainder of the book is divided, of thorough study of the best authorities on the period, and a vast amount of information is presented in a fairly readable form. But in many places the style is marked by too much smartness and levity to satisfy a sober taste. One need not be a stickler for the stately periods and pompous phraseology which some have held as alone consistent with the dignity of history, and yet one may question the propriety of such expressions as these—"putting the Kingship into commission—'running it by a syndicate of Parliamentary bosses'—in the language of to-day," page 37. "Charles II. landed, and began to play the part of a dummy king or Aunt Sally in a game of Presbyterian skittles," page 71. "Like the sole survivor of Mr. Gilbert's *Nancy Bell*, it (the Parliament) seemed to fancy it actually was the King, Lords, and Commoners, because it had swallowed them all up." Such sentences certainly strike the reader, but we doubt if they really help a serious student. There seems to us also too much readiness to apply latter-day illustrations without sufficient regard for fitness or applicability. It may be questioned whether the parallel between the Puritan Revolution and the French Revolution, at the outset of Chapter IV., is not misleading. Here is another questionable remark following the record of Cromwell's death: "Pym might be President of the Reform and Strafford of the Carlton Club; but the bust of Oliver Cromwell would be as much out of place in any of our political clubs to-day as the Ark of Jehovah was in the temple of Dagon."

The book contains much useful guidance for further reading, and an appendix gives a tolerably full list of contemporary literature, and modern poems and romances, likely to prove helpful to the student. A second appendix consists of a dozen closely compressed biographical outlines.

Blackie's School Classics: Shakespeare's Play of Henry V., with Introduction and Notes. By W. Barry, B.A. London: Blackie and Son, Limited.

This is a very handy edition of Shakespeare's fine historical play. It is well adapted for the use of schools, and especially for young students preparing for the university, local, and other examinations, where a knowledge of this play may be required. The introduction is brightly written, and the notes are of the most serviceable kind, the fault of over-annotation being carefully avoided. Prefixed to the notes on each act is a well-written summary of the argument of the act; and at the end of the book various points to be observed are arranged under special headings, as historical inaccuracies, grammatical peculiarities, classical allusions, puns, proverbs, and familiar quotations. The work of Mr. Barry deserves commendation, and imitation by other editors of English classics for school use.

Stories for the School Room. Adapted and edited for class-reading. By J. H. Yoxall. Infant Reader, and Books IV. and V. London: Blackie and Son, Limited.

These three books complete the series of which we had the pleasure of speaking favourably on the appearance of the previous numbers. The Infant Reader is introductory and contains two continuous stories and a selection of childish verses well-adapted to amuse the little ones, and make the reading lesson attractive to them. Of the stories, one—'The Tiny Tar' is by Miss Rooper, and the other 'Jack and Jill' by the editor of the series. Both are of the kind to interest young children; simple in language and matter, and sufficiently varied to stand reading more than once.

Book IV. contains four stories, amongst them being Mrs. Corkran's translation of Georges Sand's story, 'The Wings of Courage,' and an abridgment of the Rev. S. Baring-Gould's Icelandic Romance, 'Grettir the Strong.' The poetry to read and learn includes two fine old ballads, 'The Heir of Linne,' and 'Adam Bell.'

Book V. presents us with a pleasant domestic story of the last American War, 'Four Lasses and a Lad'; a selection from Dumas' wonderful romance, 'Monte Cristo;' another, 'The Managerie Lad,' from George MacDonald; and some well-chosen chapters from 'the Pathfinder,' by Fennimore Cooper. This excellent selection of stories is followed by three poems: Wordsworth's 'Harry Gill and Goody Blake'; Browning's 'Pied Piper of Hamelin'; and Miss Ingelow's stirring ballad of 'Winstanley.'

The books are remarkably well edited, suitably illustrated, carefully printed, and neatly bound. They deserve to be widely used.

Periods of English History: I. Mediæval England; II. The Reformation and the Revolution; III. Great Britain and Ireland. Edited by W. Scott Dalgleish, M.A., LL.D. London: T. Nelson and Sons.

The divisions of this work are based on the schemes of the Oxford and Cambridge Local and other examinations, and the volumes are especially adapted for the help of candidates preparing for these examinations. The various chapters are written in a bright and clear style, likely to impress the matter upon the minds of the student, and almost every kind of help is introduced to make the books more serviceable to candidates. Thus, the paragraph headings and important dates are boldly printed in Clarendon type, footnotes are given to explain and illustrate facts connected with names of persons and places mentioned in the text, separate paragraphs are added, at frequent intervals, to show the position of affairs in foreign countries, so that the contemporary history of those countries may not be lost sight of. Every chapter is followed by a list of Chief Events, with dates, and another of Great Names. Numerous genealogical trees, and maps and plans are supplied. One result of this multitude of useful helps is that the same fact often appears in two, three, or four different places; but seeing how necessary repetition is to fix facts in the memory, this may be regarded as a merit rather than a defect.

Constitutional History very properly occupies an important place in the text, and at the end of each volume is given an excellent summary of the Constitution, and a very full glossary of historical terms. In this, there is perhaps a little needless repetition, as for instance, where we find under Assize a reference to the Bloody Assize of Judge Jeffreys, and in the very next paragraph a slightly expanded reference to the same event. So Attainder is explained in the glossary, both in Volume II. and in Volume III. This may be necessary to meet the case of students having to prepare only one of the periods.

Facts relating to the state of society at different epochs are very satisfactorily presented, and the amount of information given in every department seems to be ample for the purpose aimed at by the editor, and that it is given in an interesting manner is testified by the pleasure we have felt in a continuous reading of the work. Events of very recent date are

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included, for we find mention of the death of Lord Tennyson, and the appointment of the 'Evicted Tenants' Commission;' and in the glossary as well as in the text we have explanations of the Closure, Home Rule, Liberal Unionists, and Parnellites.

A full index is added to each volume. As regards appearance and material production, 'Periods of English History' worthily exemplify the pitch of excellence to which Messrs. Nelson and Sons have attained in their recent educational publications.

Wall Map of Sweden, Norway, and Denmark. Edinburgh and London: W. and A. K. Johnston.

This map is in no respect inferior to the other wall-sheets of the same series which have been from time to time reviewed in these columns. There is the same happy selection observable in the tinting, the same care in printing, and the same clearness in detail. The Scandinavian peninsula and its neighbour, Denmark, are, from their ancient association with this land, of especial interest to us, and we welcome therefore all the more heartily the publication of so excellent a map of the "land of the Viking." The little handbook published with the map is well deserving of attention. Its thirty-two pages contain a large amount of information, concisely and carefully arranged.

The Avon Series: The Avon English Readers. Standards III., IV., and V. London: Isaac Pitman and Sons.

The name of Isaac Pitman has long held a very honourable position in the educational world in connection with the invention and development of the successful and widely adopted system of shorthand known as Phonography. The publishing firm founded by this famous man has hitherto devoted itself chiefly to the production of works connected with shorthand and phonetics. It has recently made a new departure in the issue of a series of books on the ordinary subjects taught in elementary schools.

Before us we have three volumes, which present a very pleasing appearance in their neat and delicate binding of Cambridge blue, and which bear the title, 'The Avon English Readers.' By the way, is not the tint of the covers rather too delicate for the somewhat trying use to which books in elementary schools are subject?

As for the inside of the volumes, the type is admirable, and the matter is, in our opinion, worthy of the highest praise. The compilers have endeavoured to meet the desire for a series of reading lessons, which should be fresh and new, and in this they have thoroughly succeeded. In reading these books, the points which have struck us most are the extreme freshness of the lessons, the well-adapted simplicity of the style, and the cheerful and healthy moral tone which runs through the whole series. We are pleased also to notice that the fault of scrappiness is avoided by giving some subjects and stories, which spread over a number of lessons, and by arranging some of the lessons in continuous series. Thus, in the book for Standard III., we have a series on 'Walks in London,' and another on various insects—butterflies, bees, ants, crickets. In Standard IV. is an excellent story in three parts, 'The Knight, the Hermit, and the Man.' Four lessons on nests of birds, and four on Joseph Jacquard, inventor of the silk loom, and a series on 'Why we Drink, and What we Drink,' are special features in this volume.

In Standard V. the reading is of a higher character, and is selected from good writers. Lessons on Temperance and Thrift are given in series, and a suitable selection of stories, poetry, and natural history is interspersed. The sources of the extracts are mentioned in the contents of this book, but we miss them in the earlier ones.

In Standard IV. we notice one or two slips in grammar—'had laid' for 'had lain,' on p. 26, 'come' for 'comes' in a later lesson.

The series is one we can confidently recommend to teachers seeking a new set of readers.

The Avon English Primers. Standards III. to VII. Same Publishers.

The title of these books seems somewhat misleading. After examining a set of Avon English Readers, the words 'English Primers' prepares us for a set of introductory readers, suitable for use in infant schools or classes. Instead of that we find that these little books are class-books for the study of English according to the Government Education Code.

The Primer for Standard III. is on Words and Sentences; that for Standard IV., on Changes in the Form of Words; that for Standard V., on Uses of Words and Word-building; and the last two parts on Complex and Compound Sentences respectively, with sections on Word-building and derivation. Each book includes brief and clear explanations, with copious exercises, well-selected and carefully graduated. The series is very well printed, and can be safely recommended for use as class-books.

Agricultural Diagrams. By Robert Wallace, Professor of Agriculture, University of Edinburgh. London and Edinburgh: W. and A. K. Johnston.

The half-dozen diagrams—numbered 13 to 18—now before us illustrate the forms of the furrow slices in ploughing, and the types of various machines used in field-work on farms. In agricultural matters, as in other lines of industry, the tendency for years past has been to substitute machine work for hand labour wherever possible, and an acquaintance with the chief types of machines utilised for this end is, of course, an important consideration for anyone desirous of acquiring even an elementary notion of modern agriculture. These diagrams of manure and seed drills, of weed eradicators, and mowing and reaping machines are so clearly and carefully drawn and printed that, next to having the real articles at hand to refer to, they are calculated to afford the best possible aid to students. In a great engineering country like ours, containing so many manufacturers of agricultural machinery, it goes without saying that the selection of a machine to be representative of a particular class of machines is a matter of considerable difficulty. Professor Wallace, however, seems to have overcome this knotty point as if it did not exist, thereby emphasising the truism that to an expert difficulties disappear, which to one less experienced would seem almost insuperable.

Pictorial Illustrations of the Seasons. London and Edinburgh: W. and A. K. Johnston.

In these four pictures a country view embracing farm and field, hedgerow, lane, and lake, is represented under the varied aspects usually considered typical of the respective seasons. Thus in Spring we have the trees with scanty garb of new foliage, the rooks nesting, the fields under the plough, and the dainty lamb an important feature amongst the live stock. Summer shows heavy-foliaged trees, the hay harvest, and the cornfields looking well forward. In Autumn the same scene is represented during corn harvest with the hayfields green with aftermath; whilst in Winter the brown foliage of autumn has given place to bare branches: all is covered with snow, and the farm hands are busy carrying fodder to the sheep and cattle outlying in the fields. Hung upon the walls of an infants' class-room we should imagine these pictures would prove both of decorative and educational value.

Natural History Plates: the Hippopotamus: Rabbits (tame and wild). London and Edinburgh: W. and A. K. Johnston.

We have no words save those of commendation to give to these plates, several examples of which have previously been referred to in these columns. They are in every way suitable for their purpose, being vigorous and faithful in drawing and colouring, and strongly mounted so as to stand plenty of hard service.

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1. 37,964 × 1,060.
2. 612,469 ÷ 7.
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11. Add 34967, 12589, 76123, 58961, 73314, 15790.

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Card 1.

1. 12,643,007 ÷ 1,008.
2. From £100 3s. 6d. take £99 1s. 11½d.
3. What can I spend, having ten shillings, and save 200 half-pence?
4. Find the sum of eighty thousand and forty pounds twelve shillings and ten pence; fourteen hundred and sixteen pounds and three farthings; twenty-five shillings and four pence farthing; eleven pounds and two pence; and £14,001 8s. 6d.

Card 2.

1. A boy was born in the year 1879; when will he be 21 years old?
2. Add 21 guineas; 11 crowns; 14 sixpences; 15 farthings; 118 shillings; 50 half-sovereigns.
3. 821,004 ÷ 62.
4. Find the difference between seventy pounds and three half-pence and one hundred and five pounds six shillings and two pence.

TEST CARDS—*cont.*

Card 3.

1. 29,648 × 3,090.

2. 864,297 ÷ 7.

3. 7,621,021 ÷ 66.

4. Find the quotient of 7 hundred and 42 thousand, one hundred and sixty-eight, and 765.

5. £6 6s. 0¾ + £18 19s. 2½d. + £64 2s. 11d. + £14 1s. 5d.

6. Add together £100; £1,004 7s. 10d.; £86 3s. 2¾d.; £408 7s. 9½d.; £26 2s. 2¼.

7. £688 12s. 7d. − £604 0s. 9¼d.

8. How much greater is £706 0s. 11d. than four hundred and nine pounds and three farthings?

9. A boy had 60 marbles. He gave away twenty and sold ten. How many had he left?

10. Add 8 guineas, a score crowns, 90 pence, 6 florins and one shilling.

11. Add 4568, 3293, 5174, 7124, 9598, 4764.

Card 4.

1. 82,714 × 4,030.

2. 687,492 ÷ 12.

3. 641,280 ÷ 64.

4. Divide three million three hundred and eighty thousand and seventy-five by three hundred and eighty.

5. £21 1s. 11¾d. + £400 0s. 9½d. + £96 4s. 0d. + £68 10d.

6. Find the sum of £1,800 7s. 3d.; £270 4s. 0¾d.; £648 10s. 5½d.; £10 4s. 11¼d.

7. £101 1s. 11½d. − £99 0s. 11¾d.

8. From ten thousand and ten pounds, take nine thousand and seven pounds 11s. 8½d.

9. A man sold a cow for £12 and a pig for £3. How much was he short of £20?

10. Add 14 farthings, 18 guineas, 16 half-crowns, 10 sixpences.

11. Add 35796, 58421, 47965, 15207, 86423, 57937.

Card 5.

1. 20,560 × 2,090.

2. 300,278 ÷ 6.

3. 220,200 ÷ 22.

4. What is the 125th part of nine million eighty-six thousand seven hundred and forty-two?

5. £22 1s. 11d. + £4 19s. 9¼d. + £80 2s. 0½d. + £69 4s. 7½d.

6. Add together £110 4s. 3d.; £2,224; £68 5s. 5¾d.; £22,070 14s. 9½d; £802 15s. 4½d.

7. £160 19s. 6½d. − £84 2s. 9½d.

8. Take seventeen shillings and three farthings from eighty-six pounds and one farthing.

9. What is left from a sovereign after spending 5 half-pence?

10. Add 4 half-guineas, a score farthings, 18 sixpences, 10 three-penny pieces.

11. Add 12345, 67894, 68249, 97531, 35642, 18279.

EXAMINATION TESTS—*cont.*

Card 3.

1. A teacher had 215 marbles to divide: he gave 11 boys 18 each; how many had he left?

2. £16 4s. 2d. + £90 13s. 10½d. + £4 1s. 3¾d. + £25 0s. 0½d. + £76 15s. 8½d.

3. How many times is seventeen contained in two thousand eight hundred and ninety?

4. £8,620 7s. 6d. — £1,743 0s. 4½d.

Card 4.

1. After giving away £18 I have left 3 guineas. What had I at first?

2. 16,213 ÷ 19.

3. From £11,200 0s. 6d. take £10,001 19s. 2½d.

4. Find the product of thirty-seven thousand and nineteen and thirteen hundred, and divide the answer by nine.

Card 5.

1. A grocer sells ten casks of sugar and gains four shillings and sixpence on each cask. How much does he gain altogether?

2. Add together 44 sixpences; 15 guineas; 94 pence; 6 half-crowns; and 60 farthings.

3. By what amount does £1,002 4s. 6½d. exceed £942 11s. 0¾d.?

4. How often can 640 be taken from two hundred and nine thousand and forty-five?

TEST CARDS—*cont.*

Card 6.

1. 91,881 × 1,642.
2. 992,748 ÷ 9.
3. 283,429 ÷ 24.
4. Find the quotient of three hundred and eighty thousand six hundred, and seventy-two.
5. £18 4s. 2¾d. + £9 1s. 11½d. + £70 18s. + £24 1s. 10d.
6. Find the sum of £144 11s. 2d.; £1,020 14s. 9¼d.; £264 7s. 10¾d; £800 2s. 3½d.
7. £608 0s. 0½d. − £32 0s. 9¾d.
8. Take one million and ninety pounds four shillings and three-pence from one million one hundred pounds and three half-pence.
9. A man had £20 in the bank and £4 4s. 6d. in his pocket. How much had he altogether?
10. Add 18 pence, 20 guineas, 66 farthings, a dozen crowns.
11. Add 88712, 21788, 17203, 30215, 56724, 63029.

Card 7.

1. 99,616 × 4,928.
2. 862,430 ÷ 11.
3. 868,602 ÷ 43.
4. Divide 2 million eight hundred and six thousand six hundred and forty-six by 303.
5. £303 4s. 3d. + £29 + £16 2s. 10½d. + £4 11s. 0¾d.
6. What is the sum of £6,004 2s. 8d.; 19s. 6½d.; £24 11s. 4¼d.; £900 4s. 10d.; £60 1s. 6¾d.?
7. £117 − £36 0s. 9½d.
8. After taking £439 10s. 1½d. from one thousand and ninety-two pounds, twelve shillings, and four pence half-penny, what sum is left?
9. Divide 88 apples among 44 children. How many will each child receive?
10. Add 16½ pounds, 21 half-pence, 9 sixpences and 22 guineas.
11. Add 35123, 68271, 93816, 56789, 32543, 18719.

Card 8.

1. 97,524 × 3,825.
2. 892,160 ÷ 6.
3. 1,836,300 ÷ 15.
4. Find the quotient of seven hundred and three thousand five hundred and seventy-two and 204.
5. 10s. 6d½d. + £24 0s. 4¾d. + £48 16s. 7d. + £90 18s.
6. What is the sum of £6,008 2s. 9d.; 14s. 6d.; £420 11s. 4½d.; £92 0s. 7¾d.; £2,040 0s. 0¼d.?
7. £36 4s. 11¼d. − £19 16s. 0¾d.
8. From two thousand and eighty pounds eight shillings and sixpence three farthings, take one thousand and twelve pounds eight shillings and ten pence.
9. £30 minus 15 guineas.
10. Add 29 guineas, 18 farthings, 80 florins and 4 and a half crowns.
11. Add 83931, 27426, 71698, 54537, 97543, 13246.

EXAMINATION TESTS—*cont.*

Card 6.

1. A man walks fourteen miles in a day. How many miles will he go in 2 weeks? (He does not walk on Sundays.)
2. Find the 146th part of five million ninety thousand and fifteen.
3. From 100 guineas take £46 15s. 3d.
4. Add together seventeen shillings and four pence farthing; nine hundred and fifty pounds eighteen shillings and ten pence half-penny; eleven hundred and sixty-two pounds three shillings and three pence; £400 5s.

Card 7.

1. Divide the product of 1,624 × 25 by 180.
2. Find the total of 11 half-guineas; 40 florins; 128 farthings; 10 sixpences; 3 half crowns.
3. A woman bought a jacket for 14 shillings; a hat for 10 shillings; an umbrella for 12 shillings. How much change would she want if she gave the draper a five-pound note?
4. Which is the greater £36,204 10s. 0½d. or £36,327 0s. 11½d. and by what sum?

Card 8.

1. There are 6 classes in a school and each class requires 35 slates. How many slates will be needed to supply the whole school?
2. By what sum is one hundred thousand and forty pounds and ten pence greater than one hundred and forty-two pounds and three-half-pence?
3. Add together £64 3s. 6d.; £84 1s. 9½d.; £32 18s. 3¾d.; £9 10s. 10d. and 17s. 2¼d.
4. How many times does 426,008 contain 420?

Test Cards—*cont.*

Card 9.

1. 64,974 × 4,781.

2. 1,872 ÷ 12.

3. 57,291 ÷ 61.

4. Divide six hundred thousand eight hundred and seventy-eight into three hundred and forty-four parts.

5. £11 4s. 0¾d. + 19s. 6¼d. + £42 4s. 10¼d. + £62 10s. 4d.

6. Add together £1,080 4s. 2d.; £24 11s. 5⅜d.; 18s. 7d.; £23 14s. 3½d.; £900 6s. 2½d.

7. £888 4s. 0¼d. − £126 0s. 9¼d.

8. What is left after subtracting three pounds and three halfpence from sixty pounds and one farthing?

9. A man earns £30 and spends £8, £10, and £2 10s. What has he left?

10. Add 3 half-crowns, 14 guineas, 18 pounds, and 49 sixpences.

11. Add 63214, 12359, 98765, 43218, 61491, 88327.

Card 10.

1. 58,784 × 7,213.

2. 684 ÷ 9.

3. 2,860 ÷ 13.

4. What is the quotient of 7 million two hundred and two thousand five hundred and four, and one hundred and ninety-five?

5. £41 11s. 3d. + £80 2s. 9¼d. + 16s. 10d. + £45 8s. 4¾d.

6. Find the sum of £27; £3,080 6s. 2d.; £18 11s. 1½d.; £214 3s. 11¼d.; £500 10s. 4¾d.

7. £686 3s. 3d. − £129 13s. 3d.

8. Take one hundred pounds ten shillings and a halfpenny from one hundred and one pounds and a penny.

9. If a man spends 12s., 1s. 8½d., and 3d. out of a sovereign, what has he remaining?

10. Add 18 guineas, 4½ sixpences, 5 half-sovereigns, 3 three-penny pieces, and six farthings.

11. Add 82139, 93128, 77534, 34567, 89123, 45678.

Card 11.

1. 87,514 × 607.

2. 1,008 ÷ 12.

3. 663,116 ÷ 71.

4. Divide four hundred and ninety thousand and seventy-seven by one hundred and fourteen.

5. £80 2s. 11d. + £14 + £10 5s. 5¾d. + £4 14s. 9½d.

6. Add together £2,009 7s. 6d.; £82 14s. 5½d.; £30 11s. 2¾d.; £340 10s. 6½d.; 14s. 10¾d.

7. £722 4s. 0¼d. − £36 0s. 9½d.

8. Take ninety-seven pounds four shillings and three farthings from £26,970 0s. 11¾d.

9. Divide the product of 410 and 20 by 11.

10. Add 26 shillings, 34 farthings, 3 crowns, and 20 sovereigns.

11. Add 57864, 29183, 46356, 91778, 25467, 23456.

Examination Tests—*cont.*

Card 9.

1. A man has a score and a dozen sheep. He sells 15. How many are left?

2. What is the sum of 10 crowns; 26 pounds; 145 pence; 14 guineas; 40 sixpences?

3. How many times can 49 be subtracted from two hundred thousand and seventy?

4. £83,624 11s. 5½d. — £72,315 1s. 11½d.

Card 10.

1. Add together £618 2s. 4d.; 2,090 12s. 0½d.; one thousand and ten pounds five shillings and three pence farthing; eleven hundred pounds fourteen shillings and a halfpenny; sixteen shillings and tenpence.

2. How much less is £286 4s. 0½d. than £1,000 2s. 6¼d.?

3. There were 66 scholars in a class. Six left; the remaining children were arranged in 5 rows. How many would be in one row?

4. 368,274 ÷ 132.

Card 11.

1. A horse cost 36 sovereigns, a cart £15, and harness £3. How much more did the horse cost than the cart and harness together?

2. How many times is 174 contained in one million eight hundred and two thousand and sixty?

3. By what amount does £1,214 6s. 10d. exceed £1,118 4s. 11¼d.?

4. Find the amount of 4 guineas; 6 crowns; 144 farthings; 10 half-sovereigns; and 69 pence.

TEST CARDS—*cont.*

Card 12.

1. 64,754 × 196.
2. 1,200 ÷ 5.
3. 6,813,017 ÷ 88.
4. What is the 120th part of seven million six hundred and nineteen thousand one hundred and one?
5. £26 + £42 16s. 3½d. + £36 10s. 7¼d. + £300 1s. 6¼d.
6. Find the total of the following:—£2,700; £18 6s. 8½d.; £901 13s. 0¾d.; £1,042 7s. 1¼d.; £60 0s. 4½d.
7. £16 5s. 9¼d.—£8 16s. 11½d.
8. From three million four hundred and ninety-two pounds seven shillings take seventeen thousand six hundred and ten pounds 19s. 4d.
9. I spent £5 and £3 10s. How much had I left out of a £10 note?
10. Add 201 pence, 12 and a half pounds, 11 half-pence, and 300 shillings.
11. Add 428164, 121936, 210468, 638924, 819567, 327483, 727994.

Card 13.

1. 79,564 × 5,005.
2. 27,468 ÷ 4.
3. 2,828,602 ÷ 93.
4. What is the quotient of 7 million six hundred and eight thousand and fifty and four hundred and two?
5. £4 11s. 0½d. + £16 5s. 3d. + £12 14s. 0½d. + 19s. 7¼d.
6. Find the sum of 12s. 6d.; £2,714 1s. 8½d.; £900; £88 4s. 3½d; 9¾d.
7. £820 4s. 0½d. — £19 13s. 7d.
8. Subtract twenty-six thousand and ninety pounds nine shillings and three farthings from £26,400 19s. 3½d.
9. A farmer had 100 sheep. 10 died, and he sold 25. How many had he left?
10. Add 88 sixpences, 100 florins, 15 pence, and 25 farthings.
11. Add 31465, 19876, 51732, 19408, 35216, 12345.

Card 14.

1. 7,908 × 6,079.
2. 52,000 ÷ 8.
3. 971,859 ÷ 64.
4. Divide forty-four thousand six hundred and eighty-four by two hundred.
5. £20 + £4 9s. 2½d. + £70 13s. 4d. + £25 0s. 10½d.
6. What is the total of the following:—£6,840; £14 7s. 3½d.; £216 5s. 5¾d.; £362 18s. 10¼d.; 10s. 4½d.
7. £39 5s. 7d. — £29 15s. 9d.
8. Take eighty-four thousand pounds and one farthing from eight million four hundred and six thousand and fifty pounds eleven shillings and four pence.
9. A man has £4 3s. 0d. How much more would he require to have £5?
10. Add 86 shillings, 21 guineas, 18 half-pence, and 9 half-crowns.
11. Add 98531, 76420, 54679, 32812, 51408, 73216.

EXAMINATION TESTS—*cont.*

Card 12.

1. By how much does £8,624 1s. 0½ exceed £7,920 0s. 11d.?
2. Find the quotient of seven millions sixty-two thousand and eighty-nine divided by 740.
3. Find the amount of £4,820 11s. 3½d.; £5,112 15s. 1d.; twelve hundred and eighty-two pounds three shillings and three-farthings; fifty-two pounds fourteen shillings and sixpence-farthing; ten shillings and a half-penny.
4. A farmer had 40 sheep. Four died, and he sold sixteen. Afterwards he bought 10 from another farmer. How many had he then?

Card 13.

1. Take £10,354 0s. 11d. from £11,000 4s. 2½d.
2. A man earns 3s. in each of three days and 4s. every other day in a week. How much less than 30 shillings does he earn in a week (not working on Sunday)?
3. Divide two millions seventy thousand and sixty-four by half of 100.
4. £64 2s. 1½d. + £73 18s. 10¾d. + £100 6s. 4d. + £342 14s. 8¼d. + £31 5s. 2¾d.

Card 14.

1. What is the 154th part of nine millions seven hundred and sixteen thousand and nine?
2. Subtract £1,004 6s. 8½d. from £2,001 11s. 2¾d.
3. A man earns £3 a week; he saves 10s. and gives away 9d. What does he spend?
4. Find the sum of three hundred and four pounds twelve shillings and five pence; eighteen thousand pounds and ten pence farthing; ten thousand five hundred and seventeen pounds four shillings and three farthings; £25,217 11s. 3½d.

TEST CARDS—*cont.*

Card 15.

1. 80,018 × 976.
2. 2,304 ÷ 6
3. 369,825 ÷ 17.
4. Find the quotient of seventy-six thousand three hundred and twenty-five and four hundred and seven.
5. £80 5s. 7d. + £9 3s. 0½d. + £22 14s. 10d. + £3 2s. 4¾d.
6. What is the sum of £8,800 3s. 11d.; £24 1s. 6½d.; £5 2s. 10¼d.; £622 5s. 3d.; £1,243 0s. 8¼d?
7. £160 4s. 6d. – £109 0s. 10½d.
8. From six hundred thousand pounds and three half-pence take six hundred and four pounds eight shillings and three pence.
9. What change after spending £1 6s. 10½d. from a 5 pound note?
10. Add 3 half-guineas, 13 farthings, 9 crowns, and 10 sovereigns.
11. Add 36211, 79758, 81497, 17864, 43503, 52420.

Card 16.

1. 55,601 × 916.
2. 4,907 ÷ 7.
3. 1,679,006 ÷ 37.
4. Divide sixty-six thousand three hundred and forty-two by three hundred and fifteen.
5. £3 4s. 6d. + £12 13s. 4½d. + £21 3s. 10d. + £17 8s. 0d.
6. Add together £2,714 1s. 6d.; £4 13s. 2½d.; 19s. 7d.; £3,210 12s. 3½d.; £117 18s. 0¾d.
7. 6,300 4s. 8d. – 1,001 14s. 1½d.
8. Subtract one thousand and thirteen pounds 19s. 10½d. from £39,339 and sixpence half-penny.
9. Divide 80 children into 5 classes. How many in one class?
10. Add 5 threepenny pieces, 1½ guineas, 46 florins, 103 shillings.
11. Add 22971, 43548, 67876, 95132, 48260, 24689.

Card 17.

1. 60,007 × 2,345.
2. 16,008 ÷ 7.
3. 847,050 ÷ 38.
4. What is the quotient of two hundred and eight and seven hundred and 76 thousand three hundred and fifty-six?
5. £14 + £6 3s. 10½d. + £12 19s. 0¼d. + £8 7s. 4¼d.
6. Add together £200 7s. 8d.; £3 18s. 2¼d.; 19s. 3½; £6,412 1s. 10¾d; £2,102 13s. 4½d.
7. £722 – £8 9s. 10d.
8. Take nine hundred pounds and eleven pence three farthings from £207,004 sixteen shillings and three pence half-penny.
9. How many times is 15 contained in 90?
10. Add 8½ crowns, 16 half-pence, 10 guineas, and 110 florins.
11. Add 12345, 64714, 73159, 82276, 91630, 58214.

EXAMINATION TESTS—*cont.*

Card 15.

1. 1,270,403 ÷ 2,017.
2. How much is four thousand pounds six shillings and tenpence less than £10,216 13s. 1½d.?
3. A man earns £2 a week (6 days). On each of the first three days he earns 6s. On each of the two next days 7s. How much does he earn on the sixth day?
4. Find the sum of £20,416 8s. 3½d.; £9,110 6s.; seventeen thousand and twenty-five pounds eleven shillings and five pence; ten shillings and three farthings; twelve thousand pounds.

Card 16.

1. If one box contained 36 pencils, how many pencils would there be in 800 boxes?
2. Subtract from four hundred sovereigns and a penny £322 3s. 0½d.
3. Multiply 30,046 by 25 and divide the answer by 280.
4. Add twenty-five thousand and eighteen pounds six shillings and a farthing; four thousand three hundred and ninety-five pounds eighteen shillings and two-pence; fifteen shillings and ten-pence three farthings; and £14,260 10s.

Card 17.

1. How many times can four thousand and sixty-five be taken from twelve millions one hundred thousand and fifty-two?
2. £98 4s. 2d. + £36 14s. 0¼d. + £200 5s. 2½d. + £82 12s. 3½d. + £312 8s. 1d.
3. From £88,042 11s. 0½d. take £81,927 12s. 3½d.
4. A train travels 40 miles an hour. How many miles would it go in twenty-two hours?

TEST CARDS—*cont.*

Card 18.

1. 86,086 × 1,903.

2. 200,426 ÷ 12.

3. 3,827,385 ÷ 37.

4. Find the quotient of thirty-eight thousand one hundred and three hundred.

5. £10 4s. 3d. + £3 16s. 2½d. + 10s. 6d. + £19 11s. 11¼d.

6. Find the total of the following :—£6,250 0s. 10d.; £8 4s. 9½d; £324 16s. 2d. + 11s. 5½d.; £3,114 19s. 2d.

7. £215 0s. 8d. – £36 18s. 2¾d.

8. What is left when one hundred thousand pounds four shillings and nine pence half-penny is taken from one million pounds eight shillings and one half-penny?

9. A girl lost half-a-sovereign out of a guinea. How much had she left?

10. Add 4 guineas, 18 farthings, 10½ sixpences, and 2 crowns.

11. Add 31786, 94521, 75413, 62537, 39764, 14529.

Card 19.

1. 99,718 × 564.

2. 333,034 ÷ 11.

3. 7,200,638 ÷ 72.

4. What is the 332nd part of sixty-six thousand seven hundred and twenty-four?

5. £18+£7 4s. 3½d. + £26 12s. 10d. + £30 4s. 9¾d.

6. Find the sum of £92 1s. 8d.; £68 13s. 6¼d.; £4,007 2s. 0¾d.; £842 10s. 9½d.; 15s. 3¾d.

7. £6,004 19s. 7½d. – £1,603 0s. 6¾d.

8. Subtract one hundred and one pounds four shillings and eleven pence from one thousand and one pounds 7 shillings and 6 pence.

9. There are 20 children in a class. How many oranges would be required to give 2 to each child?

10. Add 99 guineas, 49 pence, 21 half-pence, and 7 half-crowns.

11. Add 51389, 47321, 98315, 78602, 25198, 58871.

Card 20.

1. 9,014 × 625.

2. 12,084 ÷ 12.

3. 428,644 ÷ 51.

4. Divide 3 million 275 thousand and three by three hundred and twenty-seven.

5. £20 4s. 6½d. + £8 15s. 3¾d. + £38 14s. 10½d. + £11 6s. 8½d.

6. Add together 19s. 8½d.; £2,860 4s. 6½d.; £34 3s. 10½d.; £3,000 17s. 3½d; £26 10s. 5¾d.

7. £30 7s. 0½d.— £2 14s. 6½d.

8. Take nine thousand and nine pounds eighteen shillings and three half-pence from £8,430,007 4s. 6d.

9. Add together 14s. 3d.; 2½d.; 4s. 10¼d., and take the answer from one pound.

10. Add 10 half-guineas, 6 crowns, 14 and a half sovereigns, and 88 farthings.

11. Add 35798, 89146, 64517, 30051, 79352, 13087.

EXAMINATION TESTS—*cont.*

Card 18.

1. Take £3,217 0s. 3½d. from £9,308 1s. 0½d.

2. Divide the product of 600 and 17 by 24.

3. How many oranges would it require to give 30 girls four each and 30 boys half as many each as one girl received?

4. What is the sum of twenty thousand nine hundred and fifty-two pounds eight shillings and eleven pence; fourteen shillings and five pence half-penny; eighteen thousand and one pounds four shillings and three half-pence; and £90,212 14s. 3½d.

Card 19.

1. A man had a ten-pound note in his pocket. He bought a jacket for one sovereign, a hat for 12 shillings, and put £5 in the bank. What sum had he still in his pocket?

2. Divide 100,296 by 86.

3. How much less is £426 3s. 10½d. than £10,008 14s. 0½d.?

4. Add together ten thousand pounds; eight thousand and sixteen pounds four shillings and two pence farthing; nineteen shillings and a half-penny; sixteen thousand two hundred pounds five shillings; and £12,416 2s. 10½d.

Card 20.

1. A farmer goes to market with a five-pound note in his pocket, and takes a cow, which he sells for ten pounds. Then he buys a pig for 50 shillings and a pony for £11. How much money does he take home?

2. What is the quotient of eighteen millions fourteen thousand five hundred and ten and 1,800?

3. Take 100 sovereigns from 100 guineas.

4. Add £26 4s. 10½d.; £946 11s. 3d.; £142 13s.; £912 10s. 4½d.; £360 12s. 2¾d.

TEST CARDS—*cont.*

Card 21.

1. 67,503 × 582.
2. 43,764 ÷ 6.
3. 287,193 ÷ 51.
4. Find the quotient of 9 million 7 hundred and twenty-one thousand three hundred and eighty-four and 486.
5. £18 18s. + £2 7s. 3½d. + £4 10s. 9½d. + £23 2s. 2¾d.
6. Find the total of the following: 11s. 3½d.; £3,292 7s. 10½d.; £500; £83 14s. 9d.; £2,007 15s. 3½d.
7. £66 4s. 2¾d − £12 18s. 1½d.
8. Subtract sixty-two pounds fifteen shillings and eleven pence half-penny from sixty-four pounds and eleven pence three farthings.
9. A farmer took 80 sheep to the market, but sold only half of them. How many did he take back home?
10. Add 18 florins, 45 farthings, 200 pence and nineteen sixpences.
11. Add 31468, 52976, 86413, 67925, 21765, 49497.

Card 22.

1. 79,806 × 6,003.
2. 7,301 ÷ 7.
3. 729,415 ÷ 41.
4. Divide six million two hundred and ten thousand seven hundred and thirty-four by six hundred and twenty-one.
5. £16 4s. 3d. + £22 10s. 7½d. + £30 + £53 2s. 9¾d.
6. Find the sum of 18s. 11d.; £2,960 7s. 4½d.; £9,008 6s. 3½d.; £436 14s. 3½d.; £3,114 16s. 10¼d.
7. £797 6s. 9d. — £100 12s. 7¾d.
8. By how much does £5,480,060 17s. exceed £1,101,010 4s. 9½d?
9. A teacher divided 100 oranges among 50 children. How many did each child receive?
10. Add 99 sixpences, 10 threepences, 200 shillings, and 19 crowns.
11. Add 19058, 26179, 38360, 45241, 57378, 60394.

Card 23.

1. 1019 × 896.
2. 800,286 ÷ 2.
3. 271,306 ÷ 41.
4. What is the 215th part of 2 million 1 hundred and sixty-three thousand, eight hundred and twenty-five?
5. £3 14s. 2d. + £15 11s. 3½d. + £45 + £26 16s. 8½d.
6. Add together £6,420 5s. 5d.; £816 16s. 0½d; £4,712 13s. 9¾d; £62 4s. 0½d; £8,000 0s. 7¾.
7. £800 3s. 0½d — £10 16s. 4d.
8. How much less is nine hundred and twelve pounds, four shillings and ninepence half-penny than eighty-six thousand and one pounds, 14s. 0½d.
9. There were 40 children in a class. 8 left. The remaining number were put on 4 desks. How many on each desk?
10. Add 12 three-half-pence, 3½ guineas, 44 half-pence, 115 shillings.
11. Add 3974, 5862, 1375, 8617, 9205, 3762.

EXAMINATION TESTS—*cont.*

Card 21.

1. Subtract £2,617 3s. 10½d. from £3,082 4s. 6d.
2. A man gets 3s. 6d. a day, and to live costs him 2s. 3d. What can he save in a week (not working on Sunday)?
3. How many times can five millions, two hundred and thirty-six thousand and ten be divided by six hundred and fourteen?
4. What is the amount of 14s. 9½d; £30,219 1s. 6d.; £54,083 12s. 2½d.; nine hundred and eighty-one pounds three shillings and sixpence; twelve hundred and forty-nine pounds?

Card 22.

1. Add together sixteen shillings and seven-pence farthing; seven hundred and ninety pounds fifteen shillings and threepence three farthings; five thousand six hundred and four pounds twelve shillings and three-halfpence; three thousand and twenty-one pounds and tenpence farthing; five pounds eighteen shillings and elevenpence.
2. Find the quotient of twelve millions three hundred and two thousand and eleven and 428.
3. Take £14,208 11s. 3¾d. from £20,418 10s.
4. In a school there are 140 scholars. How many classes could be formed of 35 children in each?

Card 23.

1. Divide eight million forty-six thousand nine hundred and seventy by four thousand and fifteen.
2. By what amount is £1,200 0s. 4½d. greater than £930 18s. 6¼d.?
3. Add together one thousand and ten pounds twelve shillings and three farthings; four thousand two hundred and sixty-three pounds one shilling and five-pence farthing; 11s. 4½d.; £12,682 15s. 3d.; and £3,400 10s. 0¼d.
4. A man borrowed £6, which he paid back in four weeks. Each of the first two weeks he paid £1 5s., the third week he paid £2. What did he pay the fourth week?

TEST CARDS—*cont.*

Card 24.

1. 77,908 × 758.
2. 76,492 ÷ 4.
3. 397,421 ÷ 15.
4. Find the quotient of three million eight hundred and seventy thousand 387 and three hundred and eighty-seven.
5. £7 7s. 9d. + £8 5s. 7½d. + 14s. 3½d. + £15 2s. 1½d.
6. What is the sum of £70,004 3s. 6d.; £42 9s.; £9 7s. 7½d.; £74 16s. 3½d. and 15s. 2¼d.?
7. £16 4s. 9¾d. − £7 1s. 11¼.
8. How much greater is six million and six pounds and three-halfpence than six thousand and sixty pounds 4s. 11½d.?
9. Divide 336 marbles among 6 boys.
10. Add 14 guineas, 12½ pounds, 6 crowns, and 19 farthings.
11. Add 45178, 32367, 53951, 87238, 19714, 64003.

Card 25.

1. 11,999 × 7,014.
2. 868,686 ÷ 9.
3. 200,063 ÷ 14.
4. Find the 400th part of 2 million three hundred and forty-six thousand eight hundred.
5. £11 9s. 2½d. + £7 14s. 9d. + 10¾d. + £20 14s. 8½d.
6. Add together £77 1s. 6d.; £3,220 14s. 3½d.; 10s. 4½d.; £8,072 7s. 6½d.; £34 14s. 11d.
7. £866 4s. 0½d. − £800 9s. 5¾d.
8. Take eight hundred and nine pounds fourteen shillings and twopence halfpenny from £2,444 eighteen shillings and fivepence.
9. Find the product of 500 and 25, and divide the answer by 20.
10. Add 16 and a half sovereigns, 11 half-crowns, 145 pence, and 99 shillings.
11. Add 35798, 23456, 15972, 40368, 75564, 21369.

Card 26.

1. 80,716 × 753.
2. 14,002 ÷ 8.
3. 900,651 ÷ 21.
4. Divide three hundred and sixty-eight thousand five hundred and forty-nine by six hundred and seventy-eight.
5. 18s. 6d. + £12 4s. 7½d. + £7 15s. 3½d. + £90 10s. 4¾d.
6. Find the sum of £4,280; £27 14s. 0¼d.; £96 13s. 2½d.; £2,070 4s. 10¼d.; 13s. 3d.
7. £72 18s. 11½d. — £6 19s. 4¾.
8. By how much does 5 million and forty thousand pounds and sixpence half-penny exceed £58,327 10s. 5¾d.
9. How many times is 25 contained in 500?
10. Add 8 half guineas, 25 farthings, 119 shillings, and 18¾ pounds.
11. Add 34928, 76731, 68346, 51552, 43095, 12173.

EXAMINATION TESTS—*cont.*

Card 24.

1. A farmer has 26 cows. He puts 10 into one field, and into each of two other fields half as many, and the rest remain in the cow-house. How many are in the cow-house?
2. Divide the product of 90 and ten by twenty-six.
3. How much is £101 11s. 4d. less than £1,001 4s. 0¾d.?
4. Find the amount of £8,062 14s. 3d.; 19s. 2½d.; £32,415 16s. 0¼d.; two thousand and twenty pounds three shillings and sixpence; fifteen thousand eight hundred and forty pounds.

Card 25.

1. Divide the product of 8,642 and 6 by twenty-five.
2. Take £143 4s. 9½d. from £2,109 18s. 0¾d.
3. Find the total of six thousand and four pounds and eight pence halfpenny; nine hundred and ninety-two pounds eleven shillings and three pence three farthings; five thousand one hundred and ten pounds thirteen shillings and a farthing; 14s. 7½d.; and ten thousand and nine pounds.
4. Tom had 150 marbles. He lost 11, and gave John 12, and James twice as many as he gave to John. What number had he left?

Card 26.

1. A teacher had 3 bags of nuts. In the first bag there were 150 nuts, and in each of the other bags 200. He divided the nuts equally among 110 scholars. How many did each child get?
2. From £88,217 0s. 0½d. take 16,309 1s. 2¼d.
3. Add together £662 4s. 11d.; £348 11s. 2½d.; £14 13s. 6¾d.; £550 9s. 10½d.; and 18s. 6½d.
4. How many times can four hundred and six be subtracted from two million forty thousand eight hundred and eighteen?

Test Cards—*cont.*

Card 27.

1. 44,721 × 3,405.
2. 1,817 ÷ 6.
3. 217,428 ÷ 22.
4. Find the 481st part of 5 million ten thousand and six.
5. £20 + £4 11s. 6½d. + £16 2s. 8½d. + £43 14s.
6. Add together £2,618 2s. 0½d.; £36 11s. 3¼d.; £1 14s. 9d.; 16s. 4¾d.; £6,500 13s. 10½d.
7. £6,500 8s. 6d. − £26 14s. 0½d.
8. Subtract twenty thousand and fifty pounds two shillings and tenpence half-penny from £688,522 11s. 3d.
9. Find the quotient 1,818 and 9 and multiply the answer by 20.
10. Add 108 pence, 17 crowns, 20 florins, and one shilling and threepence.
11. Add 39467, 75813, 42549, 51763, 67227, 83418.

Card 28.

1. 92,706 × 64.
2. 86,840 ÷ 7.
3. 396,742 ÷ 23.
4. What is the quotient of one million one hundred and thirteen thousand and sixty-five, and three hundred and seventy-four?
5. 10s. 4½d. + £24 1s. 1½d. + £36 18s. 9d. + £7 13s.
6. Find the sum of £4,372; £918 18s. 10½d.; £654 12s. 3¼d.; £16 2s. 4½d.; £3,000 10s. 2½d.
7. £833 9s. 8½d. — £26 1s. 10½d.
8. How much greater is one hundred thousand and one pounds fifteen shillings and twopence half-penny than £99 15s. 8½d?
9. What is left after paying 13s. and 4s. 6d. from a sovereign.
10. Add 4 half-crowns, 20 farthings, 40 sixpences, and 18 half-pence.
11. Add 92706, 27069, 70691, 34580, 82034, 56783.

Card 29.

1. 75,639 × 246.
2. 668,612 ÷ 11.
3. 3,906,427 ÷ 60.
4. Divide nine million 326 thousand four hundred and seven by five hundred and seventy-nine.
5. £8 + £10 4s. 8d, + £29 5s. 6½ + 12s. 8¾d.
6. What is the sum of 16s. 3½d.; £13,411 2s. 7d.; £6,800 5s. 10½d.; £4 16s. 0¾d.; £12 13s. 3¼d.?
7. £200 0s. 4½ − £199 10s. 3d.
8. Take twenty thousand and eighty-two pounds, fourteen shillings and ninepence farthing from twenty thousand four hundred and sixty pounds 13s. 7d.
9. A man had 600 sheep, which he put into 6 fields equally. How many sheep in each field?
10. Add 11½ guineas, 101 pence, 51 half-pence, and 7 crowns.
11. Add 75639, 56397, 63970, 12346, 70821, 82134.

Examination Tests—*cont.*

Card 27.

1. I have 4 times £10. How much greater is that sum than £28 4s. 6d.?
2. Divide three million two hundred and twelve by four hundred and seventeen.
3. A man has a ten-pound note. He buys 2 pigs at £1 5s. each, and four ducks at 4s. each. How much has he left?
4. Find the amount of four thousand and eighty-two pounds six shillings and eight pence; nine hundred and seventeen pounds and three half-pence; fifteen shillings and ten pence farthing; six thousand five hundred pounds three shillings and three farthings; 14s. 6½d.

Card 28.

1. How much is the sum of £10 4s. 11d. and £5 0s. 6d. greater than their difference?
2. How many times may 145 be taken from 138,207?
3. Find the sum of one thousand and forty pounds ten shillings and three half-pence; eighteen shillings and six pence; four thousand and twenty-one pounds seven shillings and three pence; £27 4s. 0¾d; £900 13s. 7d.
4. £80,228 2s. 8d. minus £68,114 18s. 0¾d.

Card 29.

1. How much greater is £84,077 4s. 6d. than two thousand four hundred pounds, twelve shillings and three farthings?
2. A man worked 6 days. The first three days he earned 3/6 a day and the three remaining days he got 4 shillings each day. What sum did he earn altogether?
3. How many times is 308 contained in one million fourteen thousand and eleven?
4. Add together £72 16s. 1¼d.; £84 3s. 0¼d.; £30 9s. 11d.; 15s. 2¾d.; £28 1s. 10d.

TEST CARDS—*cont.*

Card 30.

1. 33,226 × 88.

2. 6,060,285 ÷ 5.

3. 3,074,285 ÷ 90.

4. Find the 468th part of three million seven hundred and fifty-five thousand three hundred and seventy-one.

5. £3 0s. 7d. + £9 + £14 13s. 2½d. + £25 11s. 9½d.

6. What is the total of the following: 14s. 3½d.; £3,046 11s. 0½d.; £962; £8 6s. 8d.; £4,371 2s. 6d.?

7. £2,640 − £308 19s. 11d.

8. From £4,310,040 7s. 11d. take three million nine thousand two hundred pounds seventeen shillings and a half-penny.

9. Divide the product of 710 and 25 by 16.

10. Add 12 sixpences, forty-nine and a half shillings, 11 florins, and 37 farthings.

11. Add 33226, 68429, 92864, 13579, 80403, 21312.

Card 31.

1. 29,764 × 273.

2. 964 ÷ 8.

3. 9,473,252 ÷ 93.

4. Divide four million one hundred thousand seven hundred and thirty-six by five hundred and seventy-nine.

5. £34 + £7 9s. 8¾d. + £11 14s. 3d. + £9 13s. 4¼d.

6. Add together 14s. 10¼d.; £12,462 11s. 8½d.; £3,216; £22 18s. 3½d.; £20,040 15s. 0¾d.

7. £632 1s. 11d. − 9s. 2¾d.

8. By how much does £9,003,822 15s 4d. exceed £2,580,012 16s. 9½d.?

9. There are 1,008 children in a school of 14 classes. How many children in one class?

10. Add 9 crowns, 18 farthings, 144 pence, and 36 and a half shillings.

11. Add 29746, 64297, 97421, 18350, 53824, 82406.

Card 32.

1. 97,426 × 707.

2. 6,686,002 ÷ 4.

3. 2,730,062 ÷ 13.

4. What is the quotient of two million seven hundred and ten thousand eight hundred and nine, and two hundred and thirty-five?

5. £18 + £24 3s. 10½d. + £32 14s. 3¼d. + 15s. 2½d.

6. Add together 17s. 3d.; £14,711 2s. 1⅓d.; £8,317 14s. 9d.; £622 10s. 2½d.; 11¾d.

7. £23 4s. − £19 3s. 9½.

8. How much less than one hundred pounds eighteen shillings and five pence farthing is ninety-nine pounds four shillings and nine pence three farthings?

9. Multiply 310 by 40, and divide the answer by 22.

10. Add 20 florins, 2 three-penny pieces, 100 sovereigns, and 12 guineas.

11. Add 78149, 66215, 53136, 84657, 23456, 78914.

EXAMINATION TESTS—*cont.*

Card 30.

1. How much must be subtracted from seventeen thousand pounds to leave four hundred and sixty-two pounds and sixpence?

2. How many times can forty-six be taken from eighty-three thousand and ten?

3. Subtract the difference between £5 4s. 10d. and £2 1s. 3d. from their sum.

4. Find the total of £8,612 19s. 3d.; 18s. 4½d.; £46 3s. 1¼d.; £214 11s. 6½d.; £3,202 1s. 10d.

Card 31.

1. Find the sum of £987 4s. 1⅛d.; £12 9s. 6d.; £642 14s. 8¼d.; 16s. 3½d.; £765 2s. 0¾d.

2. A man sells a cow for fourteen pounds and buys flour for ten pounds; corn for two pounds ten shillings; and a hat at five shillings. How much money has he left?

3. How much short of two thousand and eighty pounds is thirty-six pounds four shillings and ten-pence?

4. Divide two million three thousand and sixty-two by 16.

Card 32.

1. How much must be added to eighty-two pounds seventeen shillings and a farthing to make one thousand and one pounds and eight pence three-farthings?

2. A man earns £2 a week and spends £1 10s. How much will he save in 8 weeks?

3. Divide one million two hundred and twenty-six thousand by three thousand and six.

4. Find the amount of £2,917 4s. 8d.; 14s. 0¾d; £3,672 1s. 9¼d; £3,442 0s. 3d.; £368 12s. 4½d.

TEST CARDS—*cont.*

Card 33.

1. 21,703 × 710.

2. 668,600 ÷ 12.

3. 3,702,053 ÷ 35.

4. Find the 303rd part of six million four hundred and twenty-three thousand and nine.

5. £4 8s. 3d. + 10¼d. + £18 14s. 9d. + £23 4s. 0½d.

6. Find the sum of £4,220; £942 11s. 11d.; £16 14s. 3½d.; £126 5s. 4¼d.; £3,480 13s. 2d.

7. £8,006 2s. 0½ — £1,204 16s. 4d.

8. Subtract nine hundred and ninety-nine pounds, eighteen shillings and three half-pence from £999,090 and three-pence three farthings.

9. Take the sum of 10 shillings, 4s. 6d., and 10¼d. from one pouud.

10. Add 99 pence, 4 crowns, 5 farthings, and 100 shillings.

11. Add 77123, 63829, 10437, 28143, 52916, 81490.

Card 34.

1. 91,437 × 509.

2. 4,006 ÷ 6.

3. 4,296,321 ÷ 42.

4. Divide two million fifty-six thousand three hundred and seventy-six by one hundred and one.

5. 11½d. + 16s. 3d. + £10 4s. 3½d. + £26 18s. 7¼.

6. What is the sum of £1,443 11s. 0½d.; 16s. 9d.; £234 13s. 3d.; £10 7s. 9½d.; £8,000 12s. 4¼d.?

7. £300 0s. 4¾d. — 102 19s. 1½d.

8. How much less is thirty-two thousand and four pounds seventeen shillings and sixpence three farthings than £8,000,040 16s. 9d.?

9. Take five pounds and £1 11s. 9d. from a ten pound note.

10. Add 12 half-pence, 26 shillings, 3 half-guineas, 12 florins.

11. Add 80357, 64213, 45678, 90123, 45678, 91005.

Card 35.

1. 91,583 × 715.

2. 282,847 ÷ 7.

3. 9,496,234 ÷ 93.

4. Find the quotient of 6 million two hundred and seventy thousand and one and six hundred and 60.

5. £10 10s. 10½d. + 19s. 3d. + £5 14s. 2¾d. + £26 11s. 7½d.

6. Add together £12,462 1s. 6d.; £6,800 17s. 0¼d.; £12 7s. 11d.; £3,048 13s. 2½; £9 4s.

7. £663 2s. 0½d. — £92 0s. 9½d.

8. Take one million 7 thousand and 3 pounds nineteen shillings and three farthings from £3,466,205 0s. 11½d.

9. Divide the product of 146 and 17 by 30.

10. Add 3 guineas, 4 half-crowns, 8 half-sovereigns, and 16 farthings.

11. Add 88217, 71288, 56789, 98765, 43216, 65731, 82037.

EXAMINATION TESTS—*cont.*

Card 33.

1. A woman buys a jacket for thirty shillings, a hat for 8s. 6d., a pair of boots for 11s. 3d. What will she have left out of a five-pound note?

2. Find the difference between £6,002 4s. 9d. and £1,290 13s. 3¾d.

3. How many times is 38 contained in forty-nine thousand and eighteen?

4. Add seventeen pounds six shillings and three half-pence; twelve thousand and eleven pounds fourteen shillings and a half-penny; eight hundred and sixty-two pounds and three pence farthing; £42,048 11s. 6½d.; £826 10s. 7d.

Card 34.

1. Divide 3,472,810 by 317.

2. A man earns 24 shillings a week. His house-rent is 4s. 6d., food 10s., clothes 3s. 6d., and other expenses 4s. What can he save in a week?

3. Take £8,017 4s. 9½d. from £9,316 5s. 0¼d.

4. What is the amount of three hundred and ninety-one pounds five shillings and eleven pence farthing; £8,092 14s. 3¾d.; seven hundred and fifty-nine pounds and eight pence half-penny; six thousand five hundred and two pounds fourteen shillings and three half-pence; twelve shillings and three pence; and £426 11s. 8½d.?

Card 35.

1. Divide one hundred and twenty thousand five hundred and eleven by 74.

2. From £9,001 0s. 2¼d. take £6,105 13s. 0½d.

3. Find the total of eight shillings and two pence farthing; five thousand and eighty-six pounds eleven shillings and fourpence; two hundred and seventy-three pounds eighteen shillings and three farthings; five hundred and ninety-eight pounds four shillings and three pence half-penny; six thousand and one pounds.

4. James has 24 apples, and gives away 6 to John, 4 to William, and 8 to Mary. How many has he left?

TEST CARDS—*cont.*

Card 36.

1. 76,251 × 564.

2. 882,004 ÷ 11.

3. 8,210,730 ÷ 82.

4. What is the two hundred and twentieth part of six million sixteen thousand and sixty-six?

5. £28 + £40 2s. 10¾d. + £94 18s. 6½d. + 14s. 6¼d.

6. Find the total of the following:—£800 6s. 4d.; £30,528 13s.; £322 11s. 7½d.; 16s. 10¼d; £24,312 4s. 11d.

7. £10,032 4s. 6d. − £901 0s. 7d.

8. From seven million and one hundred pounds seventeen shillings and three pence, subtract £6,100,000 seven shillings and three half-pence.

9. How much change after paying £1 10s. and £3 6s. 8d. out of a five pound note?

10. Add 6 half-crowns, 10 guineas, 44 farthings, and four sixpences.

11. Add 56789, 34821, 23456, 78912, 38838, 71557, 67324.

EXAMINATION TESTS—*cont.*

Card 36.

1. What is the difference between four hundred and ninety-eight pounds sixteen shillings and three farthings and five thousand pounds and sixpence?

2. A cow cost £12, and a horse cost £8 more than the cow. What was the cost of the two?

3. What is the sum of £96,040 4s. 10d.; £30,276; fifty-seven pounds four shillings and three farthings; eight thousand and six pounds and eleven pence; £236,317 15s. 3¾d.; £197 10s. 7¼d.

4. Find the quotient of four hundred and three thousand six hundred and eighty-two and five hundred and sixteen.

ANSWERS.

TEST CARDS.

Card 1.

1. 89,925,147.
2. 99,130,823.
3. 33,190.
4. 2338 + 80.
5. £239 11s. 11¾d.
6. £2,452 9s. 5½d.
7. £624 0s. 8d.
8. £580 1s. 10½d.
9. 32.
10. £24 13s. 4¾d.
11. 302,016.

Card 2.

1. 40,241,840.
2. 87,495 + 4.
3. 10,105 + 31.
4. 84,587 + 73.
5. £248 17s. 8½d.
6. £16,247 11s.
7. £100 5s. 8½d.
8. £88 5s. 3½d.
9. 30.
10. £25.
11. 271,744.

Card 3.

1. 91,612,320.
2. 123,471.
3. 115,470 + 1.
4. 970 + 118.
5. £103 9s. 7½d.
6. £1,625 1s. 0½d.
7. £84 11s. 9¾d.
8. £297 0s. 10½d.
9. 30.
10. £14 8s. 6d.
11. 34,521.

Card 4.

1. 333,337,420.
2. 57,291.
3. 10,020.
4. 8,894 + 355.
5. £585 16s. 9½d.
6. £2,729 6s. 8½d.
7. £2 0s. 11¾d.
8. £1,002 8s. 3½d.
9. £5.
10. £21 3s. 3½d.
11. 301,749.

Card 5.

1. 42,970,400.
2. 50,046 + 2.
3. 10,009 + 2,
4. 72,693 + 117.
5. £176 8s. 4¾d.
6. £25,275 19s. 10½d.
7. £76 16s. 9d.
8. £85 2s. 11½d.
9. 19s. 9½d.
10. £2 13s. 11d.
11. 299,940.

Card 6.

1. 150,868,602.
2. 110,305 + 3.
3. 11,809 + 13.
4. 5,286 + 8.
5. £52 6s. 0½d.
6. £2,229 16s. 1½d.
7. £575 19s. 2¾d.
8. £9 15s. 10½d.
9. £24 4s. 6d.
10. £24 2s. 10½d.
11. 277,671.

TEST CARDS—*cont.*

Card 7.

1. 490,907,648.
2. 78,402 + 8.
3. 20,200 + 2.
4. 9,262 + 260.
5. £352 18s. 2½d.
6. £6,989 19s. 11½d.
7. £80 19s. 2½d.
8. £653 2s. 3d.
9. 2 apples.
10. £39 17s. 4½d.
11. 305,261.

Card 8.

1. 373,029,300.
2. 148,693 + 2.
3. 55,753+5.
4. 3,448 + 180.
5. £164 5s. 6½d.
6. £8,596 9s. 3½d.
7. £16 8s. 10½d.
8. £1,067 19s. 8¾d.
9. £14 5s.
10. £39 11s. 10½d.
11. 348,381.

Card 9.

1. 310,640,694.
2. 156.
3. 939 + 12.
4. 1,746 + 254.
5. £116 18s. 9½d.
6. £2,029 14s. 8½d.
7. £762 3s. 2¾d.
8. £56 19s. 10¾d.
9. £9 10s.
10. £34 6s.
11. 367,374.

Card 10.

1. 424,008,992.
2. 76.
3. 220.
4. 36,935 + 179.
5. £167 19s. 3d.
6. £3,840 11s. 7½d.
7. £556 10s.
8. 10s. 0½d.
9. 6s. 0½d.
10. £21 11s. 1½d.
11. 422,169.

Card 11.

1. 53,120,998.
2. 84.
3. 9,339 + 47.
4. 4,298 + 105.
5. £109 3s. 2¼d.
6. £2,463 18s. 7½d.
7. £686 3s. 3d.
8. £26,872 16s. 11d.
9. 745 + 5.
10. £22 1s. 8½d.
11. 274,104.

Card 12.

1. 12,691,784.
2. 240.
3. 77,420 + 57.
4. 63,492 + 61.
5. £405 8s. 5d.
6. £4,722 7s. 3d.
7. £7 8s. 10½d.
8. £2,982,881 7s. 8d.
9. £1 10s.
10. £28 7s. 2½d.
11. 3,274,536.

TEST CARDS—*cont.*

Card 13.

1. 398,217,820.
2. 6,867.
3. 30,415 + 7.
4. 18,925 + 200.
5. £34 9s. 11½d.
6. £3,702 19s. 3½d.
7. £800 10s. 5½d.
8. £310 10s. 2¾d.
9. 65 sheep.
10. £12 5s. 9½d.
11. 170,042.

Card 14.

1. 48,072,732.
2. 6,500.
3. 15,185 + 19.
4. 223 + 84.
5. £120 3s. 5d.
6. £7,434 2s.
7. £9 9s. 10d.
8. 8,322,050 11s. 3¾d.
9. 17s.
10. 27 10s. 3d.
11. 387,066.

Card 15.

1. 78,097,568.
2. 384.
3. 21,754 + 7.
4. 187 + 216.
5. £115 5s. 10½d.
6. £10,694 14s. 3d.
7. £51 3s. 7½d.
8. £599,395 11s. 10½d.
9. £3 13s. 1½d.
10. £13 16s. 9½d.
11. 311,253.

Card 16.

1. 50,930,516.
2. 701.
3. 45,378 + 20.
4. 210 + 192.
5. £54 9s. 8½d.
6. £6,048 4s. 7½d.
7. £5,298 10s. 6½d.
8. £38,325 0s. 8½d.
9. 16 children.
10. £11 7s. 9d.
11. 302,476.

Card 17.

1. 140,716,415.
2. 2,286 + 6.
3. 22,290 + 30.
4. 3,732 + 100.
5. £41 10s. 3½d.
6. £8,720 0s. 5d.
7. £713 10s. 2d.
8. £206,104 15s. 3¾d.
9. 6 times.
10. £23 13s. 2d.
11. 382,338.

Card 18.

1. 163,821,658.
2. 16,702 + 2.
3. 103,442 + 31.
4. 127.
5. £34 2s. 11½d.
6. £9,698 12s. 5d.
7. £178 2s. 5½d.
8. £900,000 3s. 3d.
9. 11 shillings.
10. £4 19s. 7½d.
11. 318,550.

Card 19.

1. 56,240,952.
2. 30,275 + 9.
3. 100,008 + 62.
4. 201 + 92.
5. £82 1s. 11d.
6. £5,011 3s. 4½d.
7. £4,401 19s. 0¾d.
8. £900 2s. 7d.
9. 40 oranges.
10. £105 1s. 5½d.
11. 359,696.

Card 20.

1. 5,633,750.
2. 1,007.
3. 8,404 + 40.
4. 10,015 + 98.
5. £79 1s. 5d.
6. £5,922 15s. 10½d.
7. £17 12s. 6d.
8. £8,420,997 6s. 4½d.
9. 8½d.
10. £21 6s. 10d.
11. 311,951.

Card 21.

1. 39,286,746.
2. 7,294.
3. 5,631 + 12.
4. 20,002 + 412.
5. £48 18s. 4d.
6. £5,884 9s. 2½d.
7. £53 6s. 1½d.
8. £1 5s. 0½d.
9. 40 sheep.
10. £3 3s. 1½d.
11. 310,044.

Card 22.

1. 479,075,418.
2. 1,043.
3. 17,790 + 25.
4. 10,001 + 113.
5. £121 17s. 8½d.
6. £15,521 3s. 9d.
7. £696 14s. 1½d.
8. £4,379,050 12s. 2¾d.
9. 2 oranges.
10. £17s. 7d.
11. 246,610.

Card 23.

1. 913,024.
2. 400,143.
3. 6,617 + 9.
4. 10,064 + 65.
5. £88 2s. 2d.
6. £20,011 19s. 11½d.
7. £789 6s. 8½d.
8. £85,089 9s. 3½d.
9. 8 children.
10. £9 11s. 10d.
11. 32,795.

Card 24.

1. 59,054,264.
2. 19,123.
3. 26,494 + 11.
4. 10,001.
5. £31 9s. 9½d.
6. £70,131 11s. 8d.
7. £9 2s. 10d.
8. £5,993,945 15s. 2d.
9. 56 marbles.
10. £28 14s. 4¾d.
11. 302,451.

TEST CARDS—*cont.*

Card 25.

1. 84,160,986.
2. 96,520 + 6.
3. 14,290 + 3.
4. 5,867.
5. £39 19s. 6¾d.
6. £11,405 8s. 7½d.
7. £65 14s. 6¾d.
8. £1,635 4s. 2½d.
9. 625.
10. £23 8s. 7d.
11. 212,527.

Card 26.

1. 60,779,148.
2. 1,750 + 2.
3. 42,888 + 3.
4. 543 + 395.
5. £111 8s. 9½d.
6. 6,475 5s. 4½d.
7. £65 19s. 6¾d.
8. £4,981,672 10s. 0½d.
9. 20 times.
10. £28 13s. 6½d.
11. 286,825.

Card 27.

1. 152,275,005.
2. 302 + 5.
3. 9,883 + 2.
4. 10,415 + 391.
5. £84 8s. 2¾d.
6. £9,157 18s. 4d.
7. £6,473 14s. 5½d.
8. £668,472 8s. 4½d.
9. 4,040.
10. £6 15s. 3d.
11. 360,237.

Card 28.

1. 5,933,184.
2. 12,405 + 5.
3. 17,429 + 15.
4. 2,976 + 41.
5. £69 3s. 3d.
6. £8,962 3s. 9½d.
7. £807 7s. 9½d.
8. £99,901 19s. 6½d.
9. 2s. 6d.
10. £1 11s. 2d.
11. 363,863.

Card 29.

1. 18,607,194.
2. 60,782+ 10.
3. 65,107 + 7.
4. 16,107 + 454.
5. £48 2s. 11½d.
6. £20,229 14s. 1½d.
7. 10s. 1½d.
8. £377 18s. 9¾d.
9. 100 sheep.
10. £14 7s. 0½d.
11. 361,307.

Card 30.

1. 2,923,888.
2. 1,212,057.
3. 34,158 + 65.
4. 8,024 + 139.
5. £52 5s. 7½d.
6. £8,388 14s. 6d.
7. 2,331 0s. 1d.
8. £1,300,839 10s. 10½d.
9. 1,109 + 6.
10. £3 18s. 3½d.
11. 309,813.

Card 31.

1. 8,125,572.
2. 120 + 4.
3. 101,862 + 86.
4. 7,082 + 258.
5. £62 17s. 3¾d.
6. £35,742 19s. 10½d.
7. £631 12s. 10½d.
8. £6,423,809 18s. 6¾d.
9. 72 children.
10. £4 13s. 10½d.
11. 346,044.

Card 32.

1. 68,880,182.
2. 1,671,500 + 2.
3. 210,004 + 10.
4. 11,535 + 84.
5. £75 13s. 4½d.
6. £23,652 5s. 3¾d.
7. £4 0s. 2¾d.
8. £1 13s. 7½d.
9. 563 + 14.
10. £114 12s. 6d.
11. 384,527.

Card 33.

1. 15,409,130.
2. 55,716 + 8.
3. 105,772 + 33.
4. 21,198 + 15.
5. £46 7s. 11½d.
6. £8,786 4s. 9½d.
7. £6,801 5s. 8½d.
8. £998,090 2s. 2½d.
9. 4s. 7½d.
10. £6 8s. 4½d.
11. 313,938.

Card 34.

1. 46,541,433.
2. 667 + 4.
3. 102,293 + 15.
4. 20,360 + 16.
5. £38 0s. 1½d.
6. £9,690 1s. 2¾d.
7. £197 1s. 3½d.
8. £7,968,035 19s. 2½d.
9. £3 8s. 3d.
10. £4 2s.
11. 417,054.

Card 35.

1. 65,481,845.
2. 40,406 + 5.
3. 102,110 + 4.
4. 9,500 + 1.
5. £43 15s. 11¾d.
6. £22,333 3s. 8½d.
7. £571 1s. 3½d.
8. £2,459,201 1s. 10¾d.
9. 82 + 22.
10. £7 13s. 4d.
11. 506,043.

Card 36.

1. 43,005,564.
2. 80,182 + 2.
3. 100,130 + 70.
4. 27,345 + 166.
5. £163 16s.
6. £55,964 12s. 8¾d.
7. £9,131 3s. 11d.
8. £900,100 10s. 1½d.
9. 3s. 4d.
10. £11 7s. 11d.
11. 371,697.

Examination Tests.

Card 1.

1. 12,542 + 671.
2. £1 1s. 6½d.
3. 1s. 8d.
4. £95,470 6s. 11d.

Card 2.

1. 1,900.
2. £56 1s. 3¾d.
3. 13,242 + 0.
4. £35 6s. 0½d.

Card 3.

1. 17.
2. £212 15s. 1½d.
3. 170 times.
4. £6,877 7s. 1½d.

Card 4.

1. £21 3s.
2. 853 + 6.
3. £1,198 1s. 3½d.
4. 5,347,188 + 8.

Card 5.

1. £2 5s.
2. £18 1s. 1d.
3. £59 13s. 5¾d.
4. 326 + 405.

Card 6.

1. 168.
2. 34,863 + 17.
3. £58 4s. 9d.
4. £2,514 4s. 5¾d.

Card 7.

1. 225 + 100.
2. £10 10s. 8d.
3. £3 4s.
4. £122 10s. 11d.

Card 8.

1. 210.
2. £99,898 0s. 8½d.
3. £191 11s. 7½d.
4. 1,014 + 128.

Card 9.

1. 17.
2. £44 16s. 1d.
3. 4,083 + 3.
4. £11,309 9s. 6d.

Card 10.

1. £4,820 10s. 6½d.
2. £713 18s. 5¾d.
3. 12.
4. 2,789 + 126.

Card 11.

1. £18.
2. 10,356 + 116.
3. £96 1s. 10½d.
4. £11 2s. 9d.

Card 12.

1. £704 0s. 1½d.
2. 9,543 + 269.
3. £11,268 14s. 0d.
4. 30.

Card 13.

1. £646 3s. 3½d.
2. 9s.
3. 41,401 + 14.
4. £612 7s. 3½d.

Card 14.

1. 63,090 + 149.
2. £997 4s. 6½d.
3. £2 9s. 3d.
4. £54,039 8s. 7½d.

Card 15.

1. 629 + 1,710.
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